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PAPERS TO BE PRESENTED
BEFORE THE SECTION ON

OPHTHALMOLOGY

OF THE

AMERICAN MEDICAL ASSOCIATION

Atlantic City, June 4-7, 1907

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TO THE MEMBERS OF THE SECTION ON OPHTHALMOLOGY OF THE AMERICAN MEDICAL ASSOCIATION

In presenting to the members of the Section on Ophthalmology of the American Medical Association printed copies of the papers accepted for the Section program for the session that is to be held in Atlantic City, June 4-7, 1907, the officers and executive committee are, at the direction of the Section, continuing a progressive feature which proved so satisfactory last year.

Members are reminded that the following rules have been adopted:

1. No paper will be formally read at the session, though each essayist will be allowed not to exceed five minutes in which to introduce the discussion of his paper and five minutes in which to close the discussion.
2. The member formally opening the discussion of a paper will be allowed not to exceed ten minutes, and subsequent speakers five minutes.

Members are, therefore, respectfully asked to read the papers carefully before going to Atlantic City, with a view not only of becoming familiar with the substance of the papers, but also for the purpose of preparation to take part in a more intelligent and comprehensive discussion which such a plan is certain to bring out.

The officers desire to express their appreciation of the cooperation of the essayists in carrying the plan to its present stage, and earnestly request the assistance of the members of the Section in an endeavor to make the Atlantic City session the best in the history of the Section.

ALBERT E. BULSON, JR.,
Secretary.

G. C. SAVAGE,
Chairman.

THE BOUND TRANSACTIONS

All of the within papers, together with the formal discussion of the same at the Atlantic City session, will be printed and bound in cloth, thus constituting the Transactions of the Section on Ophthalmology of the American Medical Association for the year 1907. Members of the Section and others may obtain these bound Transactions at $1 a volume by sending subscriptions to the American Medical Association, 103 Dearborn Avenue, Chicago, on or before July 1, 1907. After the volume is published the price will be $1.50.

ALBERT E. BULSON, JR., Secretary.

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Since only enough books are printed to supply the demand, many physicians, who have not attended the Association sessions, or who have neglected to send in their subscriptions before the books were published, have been disappointed in not being able to secure the Transactions desired.

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REPORT OF THE COMMITTEE ON METHODS OF MAKING TESTS WITH PRISMS

At the session of the Association held in Boston last year, certain preambles and resolutions were presented by Dr. Lucien Howe, Buffalo, concerning uniform methods for making tests of the ability of the eyes to overcome prisms. These resolutions were referred to a committee of three, with instructions to report on the subject at the next annual session, That committee, therefore, submits the following:

> "WHEREAS, Various differences now exist in the methods of making tests of the ability of the eyes to overcome prisms; and
>
> "WHEREAS, These differences have given rise to much confusion of our ideas on the subject; therefore, be it
>
> "*Resolved,* That it is the sense of the Section on Ophthalmolgy of the American Medical Association that hereafter when any member describes the ability of the eyes to overcome prisms, it is understood, unless otherwise specified, that
>
> "(A) The test-object is such as to secure the most accurate fixation.
>
> "(B) The test is made with the refraction corrected (with distance glasses for the distance tests and reading glasses for the near tests).
>
> "(C) The test is not made under a cycloplegic:
>
> "(D) The test is made with prisms from the trial case.
>
> "(E) If prisms in series or revolving prisms are used, this fact should be stated and it is then understood, unless otherwise specified, that the examiner begins with prisms which produce diplopia, and gradually decreases their strength to the point where the diplopia can be overcome."

LUCIEN HOWE,
EDWARD JACKSON,
ALEXANDER DUANE.

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CATARACT EXTRACTION.

I. IS THE CASE OPERABLE? II. PREPARATION OF THE PATIENT. III. THE ANESTHETIC.*

EDWIN E. JACK, M.D.
BOSTON.

I. IS THE CASE OPERABLE?

In opening this subject I fear that I have little to give that is new or even interesting. The question whether a case is operable must be decided from three standpoints—that of the general health of the patient, the condition of the eye and its surroundings and the state of the cataract itself. There has been, as far as I know, but little recent change in the accepted views on these points. Chronic heart, lung and kidney disease and diabetes are no longer considered bars to operation, provided the patient is put into the best general condition which his disease will permit, and also provided, of course, that this condition justifies the operation. Coughing reduced by treatment to a minimum, the inability to lie down in bed and other necessary concomitants of the diseases mentioned are not as important as the estimate of the general condition of the patient. And as the operation can to a certain extent be adapted to the needs, such diseases are of importance not so much on account of the possible difficulty in operating as from the increased susceptibility of the patient to infection by decreased resistance and to post-operative delirium with its attendant misfortunes. This, it seems to me, is about the worst of post-operative troubles. Old age also is not in itself a contraindication to operation; senility, however, is.

We have to do, in our estimate of the general condition, not with the success or failure of the operation from the point of view of vision, but with the possibilities of suppuration or plastic inflammation, entailing long suffering and many times shortening life. The statistics of suppuration in cataract cases at the Massachusetts Eye and Ear Infirmary for the last ten years show that about a third of the cases were due to infection by the hands, in most instances in connection with delirium. Marked arteriosclerosis and hypertension increase the risk of choroidal hemorrhage, but treatment will alleviate the condition somewhat and operation is justifiable. I have never seen sudden death follow cataract extraction in the old; I have, however, seen most of the other possible melancholy results, and my dread of them is genuine. It is well then to make the estimate of the general condition as carefully as possible, with the history of the past as well as the present in view. After all is done that can be there yet remains the unknown element. Patients with everything apparently in their favor may go to pieces and others with evident cause for fear go through the ordeal with astonishingly little upset.

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In the consideration of the eye and its surroundings the condition of the tear passage is of the greatest importance. There is, I think, nothing new to be said of it; it is, and bids fair to remain, the greatest source of danger, not only in its diseased state, but to a certain extent in its normal condition as a channel for infection from the naso-pharnyx. If treatment of the more ordinary kind does not relieve the case sufficiently to justify operation, we must have recourse to the extirpation of the sac, obliteration of the canaliculi with the cautery or occlusion of them temporarily with a suture. I have found in a limited experience that this last procedure has been satisfactory. It is generally regarded, I think, that a purely watery secretion from the sac is harmless. Perhaps it is in itself, but I am confident that I have seen such a discharge changed under the influence of the bandage into a virulently purulent one, and I would suggest in any such case that a preliminary test with the bandage be made for a few days.

I am distrustful of eczema. The bandage, of course, aggravates it, and either because of the trouble itself or from the irresistible desire of the patient to lift the bandage and scratch, thus causing infection, there is considerable danger. The condition of the conjunctival sac and edge of the lids also demand attention. It seems impossible, for a number of reasons, to make bacteriologic investigation a basis for operation, but in any suspected case the recommendations of Dr. C. S. Bull should be carried out:

> **A careful microscopic and bacteriologic examination should be made of the contents of the conjunctival sac in every suspected case, carrying the examination as far as the cultivation of the bacteria in a proper medium and the subsequent inoculation of the germs. If toxic germs are found in great number, no matter what their varieties, no operation on the eyeball should be undertaken until the germs have disappeared, and the conjunctival sac has been rendered as sterile as we can hope to make it.**

In a given number of infections there are always some which are not easily explained by the more ordinary and well-known causes. It is quite possible that the state of the naso-pharnyx may account for some of these. No one, of course, would operate during any acute process in that region, but there are also chronic conditions which should be taken into account, such as chronic and atropic rhinitis with crusts about the lachrymal duct, ozena and tonsillar crypts. In any case preliminary cleansing of the passages as recommended by Dr. Lippincott is an added safeguard.

The question whether the case is an operable one has to do also with the condition of the cataract—whether it is immature, ripe or hypermature. I take it that it does not come within the scope of this short paper to discuss all the problems relating to this part of the subject. It is certainly right to operate on a hypermature cataract under any conditions which make immediate operation advisable. To this form of cataract, it seems to me, the extraction in capsule is most applicable, and if it were possible to eliminate the disadvantages of this operation, hypermaturity of a cataract would be the condition of choice. The problem of the immature cataract seems about as far from solution as ever. Ripening operations have not, certainly in my part of the country, proved popular, and my own small experience has not been favorable. Intracapsular irrigation, too, has not gained the majority as adherents, certainly not as used by McKeown for the ripening of cataracts. Extraction in capsule is too hazardous, and I should feel that its performance was unjustifiable unless the prospects of an improved condition were remote and other urgent reasons for its performance were present. We meet cases, however, at times in which it would seem that the risk of operating was no more than that brought about by frequent examinations and disappointing postponements.

II. PREPARATION OF THE PATIENT.

The preparation of the patient should be general—physical and mental—in addition to that accorded the eye. The first thing of importance is the state of the bowels. Recent writers have shown how intimate and important is the relation of the eye to the intestinal canal. It would be well to inquire into the patient's history in this respect and correct any abnormality as far as possible beforehand. The customary cathartic should be given the night before the operation, followed by a saline the following morning, being sure that the effects have passed before operating.

A warm bath should be given. Shampooing the head seems to me objectionable in a patient not used to it. It is likely to cause a cold, an unpleasant accompaniment of a cataract extraction. The eyelids and surrounding region, especially the brow, should be well washed with soap and water and wiped with sterile gauze or cotton; the edge of the lids should be carefully cleaned and wiped with the same. The conjunctival sac must be washed out gently with sterile water or physiologic salt solution. In many cases, perhaps in all, it would be well to drop argyrol in the eyes for a few days beforehand. In spite of the doubts recently cast on this drug, I believe it to be a very efficient one. It was the older custom at the Massachusetts Eye and Ear Infirmary to make all these preparations the night before the operation and to bandage the eye over night, often with the addition of some antiseptic salve. The next morning the eyelids were, in many cases, stuck together and there was secretion in the conjunctival sac. This practice was soon abandoned and the cleansing was done on the morning of the operation. The present routine method, however, and the general rule of the hospital for all operative cases is to make the preparations the night before, to put White's ointment of bichlorid[1] in and over the lids and to bandage. Under this method it is rare to find the eye in the morning other than perfectly white and quiet, and free from secretion. Certainly from a clinical standpoint this has proven satisfactory, though I am not aware that any bacteriologic tests have been made. After the bandage has been removed the less done the better; gently wiping the lid margins again, as would naturally be done to remove superfluous salve, and gentle irrigation of the sac with the salt solution is sufficient. After this, until the actual operation, the eye should be kept covered with a moist piece of sterile gauze or cotton.

There is beside this another preliminary of importance —the mental preparation of the patient. I believe it helps the patient to bear the operation and the after treatment if he is told what he may expect and what is required of him. It is wise that he should believe the operation simple and that it will almost certainly be successful. He should be told what he must and what he must not do during the operation; instruct him to think not of what is being done but of what he is told to do, to make any ordered movements slowly and to be relaxed and calm.

I am not of the opinion, however, that the same mental preparation ought to be accorded the relatives and friends. Some one at least should know that the surgeon is to do something more than shell out a pea, though that simile may do for the patient. We have been so diligent in making patients comfortable concerning cataract extraction that I think the operation is generally considered simple and failure impossible, even by physicians, if I may judge from what I have heard. I think the operator owes it to himself that some one should know the true state of affairs, not necessarily, however, all the disagreeable possibilities. In the hospitals, and to a certain extent outside, tradition does much for the favorable mental preparation of the patient. One patient tells another that there is no pain to dread and that the discomfort is trivial.

Just before operating a repetition of the instructions, a short drill in the needed movements and during the

---

[1] This ointment, recommended by Dr. J. A. White of Richmond, Va., is as follows:

℞.	Hydrarg. bichloridi	gr. i		06
	Sodii chloridi	gr. v		30
	Petrolati	℥vi	180	

operation, gentle and encouraging guidance, are helps of great value. It seems to me undesirable that the patient should be in the hospital more than one day before the operation. He can in that time become perfectly familiar with the surroundings, longer than this will be spent in worry and fear. During this time the room should not be darkened. A hypnotic to ensure a good night's rest is often advisable. With the use of morphia for this purpose, and with its more prolonged use for the alleged beneficial action on the healing process, I have had no experience. I should feel that to justify such use its advantages must be many.

III. THE ANESTHETIC.

Of local anesthetics one has a considerable range of choice. My personal experience is limited to cocain and holocain. I have, however, found no one who, having experimented with alpha-eucain or beta-eucain and tropacocain, has been converted to their use. Alypin (hydrochlorid of benzoyl—2—ehyl—1, 3—tetramethyldiaminopropan—2—ol) may prove valuable, but at present little can be said about it. These anesthetics differ one from the other in the rapidity, duration and intensity of their action, in their influence on the pupil, in their irritating and antiseptic qualities and also in the amount of hyperemia they cause. They differ, too, in toxicity, holocain and cocain being the most poisonous of the group. This, however, amounts to so little that it need hardly be considered. If the patient were known to be very susceptible to cocain, tropacocain, which is the least toxic, could be substituted. Holocain has enjoyed considerable popularity on account of its having no action on the pupil, tension or corneal epithelium and because of its bactericidal properties. Of these advantages, the only practical one, it seems to me, is its freedom from action on the pupil. It is on this account, theoretically at least, more fitted for use in simple extraction than is cocain. The effect of the latter on the corneal epithelium can usually be avoided. It is not necessary to go further into detail on this subject. It would seem then that cocain was the most generally useful of the anesthetics, holocain being substituted for it in certain cases.

The method of using the cocain is of some importance. The 2 per cent. and 4 per cent. solutions are most commonly used and seem sufficient. Dropped in the eye two or three times at five minute intervals good anesthesia results. The use of a 10 per cent. solution tends to emphasize the disadvantages of cocain, and I think it preferable for anesthetizing the deeper structures, to allow a drop of the weaker solution to run into the anterior chamber, after the section has been made.

THE INCISION FOR THE EXTRACTION OF CATARACT AND THE IRIDECTOMY.*

JOHN E. WEEKS, M.D.
NEW YORK CITY.

In studying the incision employed for the extraction of cataract we need not go further back in the history of the incision than the time of Daviel.[1] The operation of extraction, as a recognized method of removing cataract originated with Daviel, the method having been matured about the year 1750.

The incision employed most frequently by Daviel and the one referred to when the term "Daviel's incision" is used is a flap incision (Fig. 1) made entirely in the corneal tissue close to the scleral margin. The cornea was first pierced by means of a broad needle at its lower margin; then, by means of small, blunt-pointed knives and by curved scissors (Daviel's scissors, right and left), the incision was continued on either side until almost two-thirds of the cornea near its margin had been divided. In the latter years of Daviel's life the incision was made shorter. In order to afford more support to the iris and to simplify the incision, Daviel introduced, during the last years of his life, a triangular incision (Fig. 2) with the base inward in some cases, with the base upward in other cases.

Since Daviel's time many forms of incision have been introduced. The principal ones will be described in chronological order.

Richter[2] advised an incision in the lower half of the cornea (Fig. 3) close to the margin of the cornea, to be employed in the operation for removing the lens in its capsule by gentle pressure after first freeing the lens from its attachments to the suspensory ligament.

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[1] Sur une nouvelle methode de guerir la cataracte par l'extraction du cristellin, Mem. de l'Acad. d. chirurgie, 1753.

[2] Abhandlung v. d. Ausziehung d. grauen Staar, Göttingen, 1773.

De Wenzel[3] employed an incision (Fig. 4) through the cornea extending from the temporal to the nasal margin in the horizontal meridian for the removal of opaque, shrunken lenses and soft-cataract. A few years later De Wenzel advocated a flap incision for the extraction of cataract (Fig. 4): The line of the incision followed the margin of the cornea ¼ line (0.5 mm.) from the sclera and extended from a point 45 degrees above the horizontal meridian on the temporal side to 45 degrees below the horizontal meridian on the nasal side, thus including one-half the circumference of the cornea. It was thought that such an incision would be less apt to gape because of the support of the upper and lower lids.

Santerelli[4] advocated a corneal flap upward, including about three-fifths of the cornea. The incision follows the periphery of the cornea, its central point falling on the vertical meridian of the cornea above (Fig. 5).

Beer[5] began to employ the Richter incision in 1790 and appears to have practiced it continuously, making the flap downward as a rule, but also making it upward in not a few cases. Beer introduced the triangular knife which still bears his name, the use of which markedly simplified the making of the incision (Fig. 3).

Mr. Wardrop[6] introduced an incision, which is described as follows (Fig. 6): Puncture on temporal side of the cornea one line from the scleral margin and a little above the transverse diameter, the direction being perpendicular to the surface of the cornea. When the point of the knife has entered the anterior chamber it is directed to a corresponding point on the nasal side of the cornea, where the counter-puncture is made. The incision is then carried a little downward and forward, then the knife is rotated sharply so that the edge is directed forward and the incision is finished by cutting directly outward, nearly perpendicular to the surface of the cornea. The incision should be made so that the lower margin of the wound is midway between the lower margin of the cornea and the lower margin of the moderately-dilated pupil. Its advantages are: 1, Large opening; 2, firm flap, not very large; 3, corneal margin broad to support iris.

---

[3] Traité de la Cataracte, Paris, 1876.

[4] Ricerche per facilitare il cateterismo e l'estrazione della cataracta, Vienna, 1795.

[5] Lehre d. Augenheilk., 1817.

[6] Practical observations on the mode of making the incision of the cornea for the extraction of the Cataract, London, 1808.

The linear incision, variously placed in the cornea and of various lengths, was employed even before the days of Daviel for removing soft lens substances.

Sir William Adams[7] employed the linear corneal incision for removing all cataracts which could be broken up.

Guthrie[8] made the incision in the lower part of the cornea, most often (Fig. 7) beginning slightly above the horizontal meridian and carrying the incision around the periphery of the cornea one line from the scleral margin. In some cases the incision was made above.

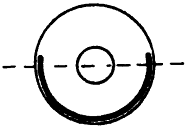

Fig. 1.—Daviel's incision.

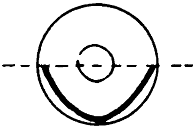

Fig. 2.—Daviel's inter-incision.

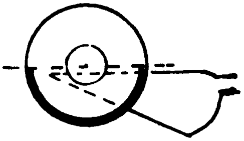

Fig. 3.—Richter's incision (Beer's knife).

Makenzie[9] advocated the flap incision and recommends that it be made in the upper part of the cornea in all cases except in those patients who have difficulty in looking down, when the incision should be made in the lower half of the cornea.

Graefe's classical linear incision was the result of his experience in the extraction of cataracts by means of the linear incision in the cornea, first employed by Palucci for removing membranous opacities from the pupillary area, and his desire to place the incision so that the loss of eyes from suppuration would be less frequent. The loss from suppuration when the corneal flap was the incision employed was from 7 to 10 per cent. Graefe urged, and very rightly so, that the healing of the wound would progress more rapidly if it were made where the blood supply was abundant, and that the resistance of the tissues to injurious influences would be greatest when the nutrition to the tissues was best. By placing the incision in the sclera he succeeded in reducing loss by suppuration very considerably. After a careful and prolonged study of the subject, evidence of which appears in the many articles on cataract extraction written by him,[10] Von Graefe selected the incision described below. The incision was placed almost tangentially to the upper margin of the cornea just below the clear margin. It described an arc in the sclera, its radius being nearly that of the sclera. It departed very little from the linear incision, having a height of from 0.50 to 1 mm. The length of the incision was from 10 to 11 mm., according to the size of the lens to be extracted (Fig. 8). The linear knife which bears Graefe's name was employed.

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[7] New Operations for the Cataract, 1817, p. 138.

[8] Operative Surgery of the Eye, London, 1830, p. 320.

[9] Diseases of the Eye, American Edition, 1855, p. 747.

One of Graefe's descriptions of his incision is as follows: The incision is made above with the narrow knife, the flat surface forward. The point of the knife is entered ½‴ (= 1 mm. plus) from the margin of the cornea and 2/3‴ (= 1.46 mm.) below a line tangential to the summit of the cornea. In order to make the inner wound as large as possible, the point of the knife is directed toward the middle of the pupil in front of the iris, and when the point has penetrated into the anterior chamber 3‴ (= 6.50 mm.) the handle of the knife is depressed and the point is pushed toward the place of counter-puncture exactly opposite the place of puncture. When the counter-puncture is made the blade of the knife is turned on its long axis, so that the back of the knife is directed toward the center of curvature of the cornea, and the incision is finished in this plane by to-and-fro movements. The knife, after it clears the sclera, is beneath the conjunctiva, which is now cut through, making a long or short conjunctival flap as desired.

Von Graefe made many experiments with conjunctival flaps.

Jacobson[11] practiced and advocated the making of an incision which was placed in the sclera 0.5 mm. from the limbus (Fig. 9), and included almost the entire lower half of the cornea. The extraction was accompanied by iridectomy.

Stellwag von Carion, about 1864, advocated an incision which was made upward in the limbus conjunctivæ and included two-fifths of the circumference of the cornea.

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[10] Graefe's Arch., i., No. 2, 219; v, No. 1, 158; xi, No. 3, 1; xiv, No. 3, 106.

[11] Ein neues u. gefahrloses operationes verfahren sur Heilung d. grauen Staars, Berlin, 1863.

Critchett[12] endeavored to make the incision as small as possible and to aid the escape of the lens by means of the curette. The incision was a flap in the upper sclerocorneal junction, including one-fourth of the circumference of the cornea (Fig. 10). The removal of the lens was preceded by an iridectomy (preliminary iridectomy). Critchett had used this method many years before the date of the above reference.

Horner, referred to by Stellwag, employed an incision wholly scleral, including one-third of the circumference of the cornea, beginning 1 mm. from the corneal margin, cutting upward and finishing the incision 1.5 mm. from the corneal margin (Fig. 11).

Steffan[13] made the puncture and counter-puncture 2 mm. below the horizontal meridian 1.5 mm. from the margin of the cornea, the distance between these points being 13 mm. The incision was so made that in individuals more than 40 years of age its lowest point was 1.5 mm. from the lower margin of the cornea (limbus); in individuals more than 45 years of age, 0.5 to 1 mm. from the lower margin of the cornea (Fig. 12).

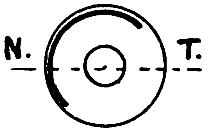

Fig. 4.—DeWenzel's incision.

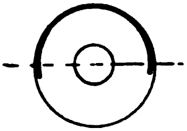

Fig. 5.—Santerelli's incision.

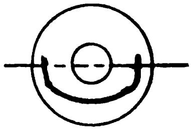

Fig. 6.—Mr. Wardrop's incision.

Weber[14] made a careful study of the incision. He advised the use of a lance-shaped knife especially constructed. It measured 10 mm. wide at 6.5 mm. from the point and maintained this measurement 2 mm. further in order that the wound on the inner surface of the cornea might be made of the same length as on the outer surface. The blade was then narrowed to the shank. The under surface of the blade was slightly concave (illustration in *Graefe's Arch.*). For making incisions in the cornea above or below, the blade was bent on the flat, 8.5 mm. from the point at an angle of 120°. Weber designed to perform extraction without iridectomy. The knife was made to enter the cornea at the sclerocorneal junction, the inner edge of the wound being removed from the insertion of the iris into the ciliary body about 3 mm. The incision was made by choice at the lower or at the lower inner margin of the cornea. When iridectomy was determined on previous to the incision, the incision was made above. The globe was fixed immediately opposite to the point of the commencement of the incision. The incision (Fig. 13) beginning at the sclerocorneal junction, was carried slightly obliquely through the tissue of the cornea. After the point of the knife had entered the anterior chamber, the plane of the knife blade was made to advance in the plane of the base of the cornea and it was introduced about 8 mm., insuring an incision of 10 to 10.25 mm. The ends of the incision extended into the sclera about 1 mm. from the corneal margin. On removing the knife, which was done slowly, slight backward pressure was made to cause as little disturbance to the iris as possible. As a rule, the conjunctiva overlapped the outer extremities of the incision a very little. This was divided if it interfered with the escape of the lens.

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[12] Ann. d'oculistique, 1864.

[13] Erfahrungen u. Studien über die Staroperation, Erlanger, 1867.

[14] Graefe's Archiv., 1867, xiii, No. 1, 187.

Iridectomy was made: 1, If the rigidity of the sphincter iridis interfered with the escape of the lens; 2, if the iris prolapsed greatly; 3, if the iris was much injured when the lens escaped; 4, if it was difficult to restore the iris to its normal position; 5, if much lens cortex remained.

Kuchler[15] advocates the use of an incision extending directly across the cornea in the horizontal meridian, beginning and ending slightly in the sclera (Fig. 14), the incision of De Wenzel slightly elongated.

Lebrun[16] introduced an incision which he termed the "small median flap," termed by Warlomont the "Belgian incision" (Fig. 15). It is a curve with the convexity upward, lying chiefly in the upper corneal segment. A medium-sized Graefe knife is employed. The puncture and counter-puncture lie at the sclerocorneal junction about 2 or 3 mm. below the horizontal meridian of the cornea. The incision ends at the junction of the upper third with the middle third of the cornea in the vertical meridian. The incision is designed to avoid iridectomy.

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[15] Die Querextraction des grauen stares d. Erwachsenen, Inaug. Diss., Erlangen, 1868.

[16] Compte rendu du Congrès de Londres, 1872, supplement, p. 217.

In 1885 Galezowski[17] advised a similar incision placed somewhat higher at the ends (2 mm. below the horizontal meridian), and likewise designed to avoid iridectomy.

Liebreich[18] advocated an incision in the lower part of the cornea, beginning with the puncture 1.5 to 2 mm. below the horizontal meridian, 1 mm. in the sclera, the counter-puncture being at a corresponding point opposite. The incision extends downward at 45 degrees for about one-half the width of the flap and is terminated by a curve, the apex of which is from 1.5 to 2 mm. from the margin of the cornea (Fig. 16). A Graefe knife was employed.

E. de Jaeger[19] advocated an incision which began in the sclera 3.5 mm. below a line tangential with the upper margin of the cornea, 2.5 mm. from the corneal margin, the counter-puncture being made at a corresponding point. The center of the incision corresponded with the clear margin of the cornea above (Fig. 17). The incision was about 12 mm. long externally, about 11 mm. long on the inner surface. The incision was made with a narrow bistoury, hollow-ground on one side, right and left. The knife was entered with the concave surface forward. This incision resembles that of von Graefe to some extent. A large iridectomy was always made.

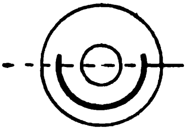

Fig. 7.—Guthrie's incision.

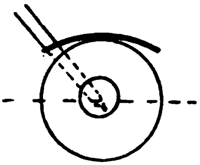

Fig. 8.—Graefe's incision.

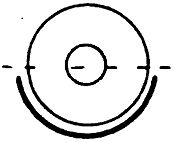

Fig. 9.—Jacobson's incision.

Arlt[20] employed an incision which is a compromise between the Graefe incision and the old flap incision. It resembles that of E. de Jaeger, differing in that it does not enter into the sclera so far and that it is placed more in the limbus conjunctivæ.

Horner[21] employed an incision beginning 1 mm. from the corneal margin, 3 mm. below a line tangential with the summit of the cornea. It had a base of 12 mm. and a flap 3 mm. high. The incision was finished in the sclera about 0.5 mm. from the corneal margin. A rather large conjunctival flap was made (Fig. 18).

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[17] Progrès méd., November, 1885.

[18] Eine neue Methode des Cataract Operation, Berlin, 1872.

[19] Der Hohlschnitt, Vienna, 1873, p. 23.

[20] Graefe's Arch., 1874, xv, No. 3, 204.

[21] Muralt: Die Starextraction d. oph. Klinik in Zurich, 1870-1880, Inaug. Diss., Zurich, 1882.

De Wecker[22] advocated the making of an incision located at the limbus conjunctivæ, forming a flap one-third of the diameter of the cornea in height. This is really an incision that includes almost two-fifths of the circumference of the cornea. A narrow Graefe knife was employed (Fig. 19).

Snellen's section is made just outside of the clear cornea (0.5 mm.), including about two-fifths of the circumference of the cornea upward, and is completed with a conjunctival flap 2 or 3 mm. long (Fig. 20). It is made with a narrow knife.

Many varieties of the incisions described have been made, the greater number falling in the upper half of the cornea being modifications of the linear or of the flap incisions (Fig 21). However, these approach the incisions described so closely that it is not necessary to be more explicit regarding them.

There is one incision that is advocated by some operators of which a few words may be written. The incision is made with a narrow (Graefe) knife. The puncture and counter-puncture are made in the limbus so as to include about two-fifths of the cornea above. The incision is then continued in the limbus with the plane of the knife in the plane of the base of the cornea until three-fourths of the incision is completed, when the knife is turned to cut directly outward. This divides the corneal tissue by the last maneuver at right angles to the surface, leaving a segment of clear cornea about 1 mm. in depth above. It is thought that the "shoulder" thus formed gives better support to the flap, and that a subsequent good healing, with slight danger of relapse of the iris, is assured (Fig. 22).

SUBCONJUNCTIVAL INCISION.

The only incision of this nature that has awakened any special interest is that described by Czermak.[23] The incision is made below in the sclerocorneal junction and includes almost one-half of the circumference of the cornea. It is commenced by a puncture, made with a wide Graefe knife, just below the horizontal meridian, cutting through conjunctiva, sclera and cornea at the scleral margin (Fig. 23). The point of the knife is advanced to the center of the pupil, preferably into the lens capsule, and is then withdrawn. A vertical incision downward in the conjunctiva, 12 to 15 mm. long, starting from the primary incision, is now made and the conjunctiva is detached from the underlying tissue. By means of specially constructed scissors, curved on the flat, the incision through the fibrous coat is continued in the sclerocorneal junction beneath the conjunctiva, until a point opposite to the puncture is reached. The other steps of the operation are then proceeded with. This extraction is performed without iridectomy.

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[22] Ann. d'oculistique, lxxv. p. 264, 1875.

[23] Klin. Monatsb. f. Augenheilk., November and December, 1903.

Knapp[24] makes puncture and counter-puncture in the limbus conjunctivæ from 0.5 to 1 mm. above the horizontal meridian of the cornea and completes the incision upward in the plane of the base of the cornea, making a small conjunctival flap. The incision includes a little more than two-fifths of the circumference of the cornea.

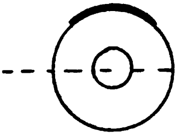

Fig. 10.—Critchett's incision.

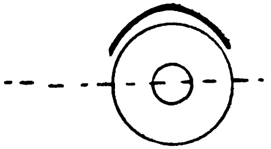

Fig. 11.—Horner's incision.

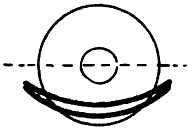

Fig. 12.—Steffan's incision.

Fuchs[25] makes the incision of De Wecker, except that he makes a small conjunctival flap.

De Schweinitz[26] makes De Wecker's incision with a small conjunctival flap

SCLERAL INCISION.

The removal of cataract by scleral incision posterior to the incision of the ciliary body is not practiced by ophthalmic surgeons at the present time. However, it is of interest to note that extraction by means of such incision has been practiced, and with success, in a certain percentage of the cases. In preaseptic days it may have possessed some merit, as the danger from infection was probably less.

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[24] System of Diseases of the Eye, Norris and Oliver, iii, 798.
[25] Lehrbuch d. Augenheilk., Achte Auf., 832.
[26] Diseases of the Eye, Fourth Edition, p. 707.

Sir James Earle[27] removed cataract by an incision in the sclera. The incision was made through sclera, chorioid and retina, in some cases parallel with the margin of the cornea (equatorially), in other cases at right angles with the margin of the cornea (meridianly), the incision being five lines in length. By means of forceps the lens was seized from behind and drawn through the wound.

Ouadri[28] reported the removal of cataract through the sclera in 25 cases, 11 of which were successful.

DESIRABLE FEATURES OF THE INCISION.

1. It must be large enough to permit the lens to escape readily. If a linear incision or an incision approaching the linear incision is made the length of the incision should be from 10.5 to 12 mm. If a flap incision is employed it should include almost two-fifths of the circumference of the cornea for a moderately large cataract if an iridectomy is to be made, and a little more than two-fifths of the circumference of the cornea if a simple extraction is contemplated.

2. The incision should be placed where the healing of the wound will be rapid. While incisions that lie wholly or in part in the cornea are permissible in young individuals whose nutritive processes are vigorous, it is not desirable to place the wound in clear cornea in the aged or feeble, because of the danger of imperfect and retarded healing. In all such the incision should lie in the limbus or a very little back of the limbus, where the nutrition necessary to promote healing can be supplied directly and abundantly.

3. The incision should be placed so that the field of operation will not be too greatly interfered with by hemorrhage. By the aid of suprarenal extracts, hemorrhage from the small vessels at the limbus can be quite readily controlled.

4. The incision should not lie too close to the ciliary body. It would seem that the region of the limbus is the most desirable location.

In the opinion of the writer a desirable section is one located in the limbus, including about two-fifths of the circumference of the cornea, directed upward and terminating with a small conjunctival flap (Fig. 24).

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27. Account of a New Mode of Operating for the Removal of Cataract, London, 1801, reported by Mackenzie.

28. Annotozioni, Prat. suelle Malattie degli Occhi, iii, 167, Naples, 1827.

POSITION OF THE PATIENT.

Whether the patient is in the sitting or prone position during the operation, the head should be so placed that the vertical transverse plane of the head dips 15 or 20 degree from the horizontal at its lower part (the chin lower than the forehead). This is attained in the chair by the position of the headrest. When the patient lies on the operating table or bed, suitable pillows are employed. Operators in the United States prefer, as a rule, to stand behind the patient while making the incision for both eyes, using the right hand for the right, the left hand for the left eye. The ability to do this is soon acquired whether the surgeon is ordinarily ambidextrous or not. If it is impossible to use the left hand for making the incision, it becomes necessary to stand or sit in front of the patient while making the incision in the left eye, when the surgeon must cut away from himself. The height of the patient's head should be so regulated that the surgeon's hands and arms will not be in a cramped position.

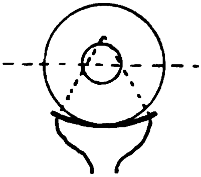

Fig. 13.—Weber's incision.

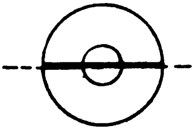

Fig. 14.—Kuchler's incision.

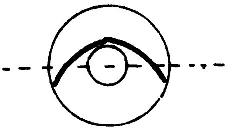

Fig. 15.—Lebrun's incision.

PUNCTURE.

The puncture should be made with the long axis of the knife almost at right angles to the surface at the limbus, and the direction should be changed so that the plane of the blade is in the plane of the base of the cornea as soon as the point has penetrated into the anterior chamber. If continued further the iris will become engaged, when the knife must be withdrawn until it is free from the iris. If much aqueous is lost by this maneuver the operation should be postponed until the anterior chamber is restored. If the point of the knife enters the tissue of the cornea at too great an angle it may pass for some distance in the lamellæ of the cornea, and in extreme cases may fail to enter the anterior chamber. Complications of this nature are especially apt to occur if the blade of the knife at and just back of the point is too flexible. The error may be readily corrected by withdrawing the knife and commencing again.

If, in passing the knife across the anterior chamber, the iris is engaged, the knife should be withdrawn sufficiently to free the point. If much aqueous is lost the knife may be entirely withdrawn, the operation may be postponed or the incision may be completed with the scissors or blunt-pointed knife.

COUNTER-PUNCTURE.

The point of the knife should be advanced across the anterior chamber, the plane of the knife corresponding with the plane of the base of the cornea, and the counter-puncture should be made at a point exactly corresponding to the puncture.

ERRORS.

(*a*) The point may be carried too far forward and emerge in clear cornea. This error is of little importance if it is not more than 1 or 2 mm. out of the way. The incision may be completed. (*b*) The point of the knife may be carried too far backward. This is a frequent error with beginners. If the iris or ciliary body is not engaged the section may be completed. If either is engaged, it is better to withdraw the knife and make a better counter-puncture, if little or no aqueous has escaped, and complete the section or withdraw the knife entirely and postpone the operation. (*c*) If a knife with a flexible point is used, the fibrous coat may be pierced very diagonally and the point emerge far back in the sclera. If the error is extreme the knife should be withdrawn and the operation postponed. (*d*) The knife may be entered with the back upward. If the blade of the knife is not too wide, this error may be corrected by quickly rotating the knife on its long axis, the sharp edge being turned toward the surface of the cornea; this is done to avoid engaging the iris on the edge of the knife. The incision may then be completed. If the knife is too broad for this maneuver, it may be withdrawn, the incision completed with the scissors, or the operation may be postponed until the anterior chamber is again restored.

The incision should be completed by long to-and-fro sweeps of the knife made rather rapidly at first, completing the section slowly; but little traction should be made on the cornea. Forward or backward pressure with the knife should be avoided. As the knife leaves the fibrous coat, the conjunctiva will be raised on its edge and a conjunctival flap of the desired length, from 2 to 3 mm., may be made.

ACCIDENTS.

(*a*) The iris may fall before the knife when the section is being completed. Injury to this membrane may sometimes be avoided by cutting corneal tissue with the toe of the knife on the thrust and with the heel of the knife on the draw without changing the direction of the incision. De Wenzel advises rubbing the surface of the cornea as the incision is being made to prevent cutting the iris in cases in which the iris falls before the knife. If these measures fail it is well to proceed with the section, removing the cut portion of the iris after the section is completed, and doing a more complete iridectomy subsequently if desirable. (*b*) The tissues of the lids and caruncle should not be pierced by the knife. Untoward movements on the part of the patient are apt to be induced by such interference.

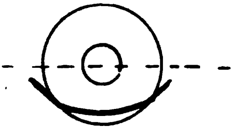

Fig. 16.—Liebreich's incision

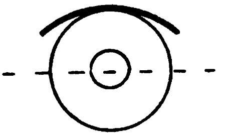

Fig. 17.—Ed. de Jaeger's incision.

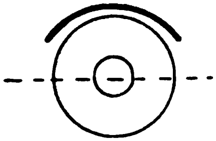

Fig. 18.—Horner's incision after Muralt.

The healing of a section as described is rapid and satisfactory. He who finishes his incisions in clear cornea in old individuals will sooner or later come to grief on account of long-delayed healing with gaping of the wound or from suppuration because of the low vitality of the corneal flap.

THE CONJUNCTIVAL FLAP.

Many operators who have carried the incision within the domain of the conjunctiva have studied the conjunctival flap. Von Graefe[29] experimented extensively with it. He made a series of 100 extractions with large conjunctival flaps and a similar series with short flaps. He concluded: 1, When the wound is fully covered by a conjunctival flap the healing is most rapid; 2, small differences in the height of the flap are of no importance; 3, the flap should not be too large, as the hemorrhage will then be profuse and the blood may enter the anterior chamber and cloud the field of operation. The subconjunctival tissue may also become infiltrated, producing undesirable conditions.

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[29] Graefe's Arch., xii, No. 1, 162.

Horner[21] always made a conjunctival flap of greater or lesser dimensions.

In my opinion a conjunctival flap is of great value, especially in old individuals and in patients who are restless. I prefer a flap from 2.5 to 3.5 mm. wide and and from one-half to two-thirds of the length of the incision at its middle. The conjunctival flap should be turned forward immediately after the incision is finished. The bleeding from such a flap, which, without the use of adrenalin, would be somewhat profuse and might to some extent interfere with the subsequent steps of the operation, is almost completely controlled by the local use of this remedy instilled into the eye a few minutes before the operation is begun. After extraction of the cataract and the reposition of the iris, the conjunctival flap should be restored to its former position by means of a spatula. A suture may easily be introduced to retain the conjunctival flap in position if it is thought to be desirable. In my experience this is seldom necessary.

IRIDECTOMY.

Iridectomy at the time of the extraction of cataract is not of recent date. Daviel, about 1750, practiced it more or less extensively. If, in the course of the operation for extraction, the iris prolapsed, he did not hesitate to excise the prolapsed portion. If the sphincter was so rigid that it interfered with the free escape of the lens, he divided it with the scissors (iridotomy).

De Wenzel (1788) performed iridectomy at the time of the extraction in some cases. At times this operator excised a portion of the periphery of the iris, leaving the sphincter intact, extracting the cataract through the opening thus made.

Operators, such as von Graefe, A. Weber and E. von Jaeger, who extracted cataract by linear incisions situated partly or wholly in the sclera, performed iridectomy as a routine measure. Those who made the extraction by means of a pronounced flap—Daviel, Richter, Guthrie, Panas and others—and those who made the incisions in the cornea wholly or nearly so—Wardrop, Steffan, Kuchler, Liebreich and others—performed iridectomy but seldom.

Critchett and Bowman performed iridectomy as a routine measure. Mooren (1862) did preliminary iridectomy some weeks before the extraction.

With the development of the knowledge of the causes of infection and the departure from the linear incision of von Graefe, the performance of iridectomy became less frequent. The operation of extraction without iridectomy was advocated by Bettremieux,[30] Abadie,[31] Panas,[32] Schweiger,[33] Knapp[34] and others.

For a number of years after the return of the operation of the extraction of cataract without iridectomy, the "simple operation," as it was styled, was much in vogue, some operators employing it almost to the exclusion of extraction with iridectomy (the "combined operation").

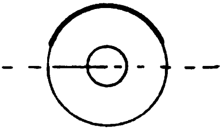
Fig. 19.—De Wecher's incision.

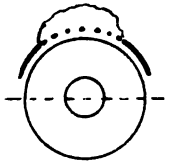
Fig. 20.—Snellen's incision.

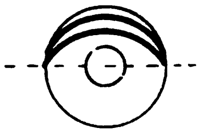
Fig. 21.—Modifications.

Within the last few years a reaction has set in. Some of those who were very enthusiastic regarding the "simple extraction," because of the annoyance and trouble both to the patient and operator entailed by prolapse of iris; also because of the difficulty of freeing the eye of cortical lens substance, and the more frequent occurrence of glaucoma after the "simple operation," are now doing the "combined operation" more frequently. It is a well-recognized fact that the visual results by the one method are as good as by the other, and, since success with as little annoyance to the patient and a minimum of anxiety on the part of the operator are after all the objects to be obtained, it is best to choose the safer course in all cases.

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30. Arch. d'ophth., 1885, p. 508.
31. Ann. d'ocul., 1886, p. 257.
32. Arch. d'ophth., 1885, p. 289.
33. Arch. of Ophth., xviii, 1887, s. 143.
34. Arch. of Ophth., xvi, 1887, p. 45.

While it is permissible to do the "simple operation" in young tractable subjects who have no history of rheumatism and gout, whose intraocular tension is not above the normal, whose irides are not atrophic and react readily, and whose lenses are not swollen, it is risky, to say the least, to do the "simple operation" in very old individuals with the gouty or rheumatic diathesis, whose blood vessels are atheromatous, intraocular tension increased, irides sluggish, lenses swollen, cataract hypermature, apt to be restless, chronic bronchial affection, asthmatic, etc.

The question of preliminary iridectomy is one on which different operators have widely different views. Theoretically, it is safer to perform iridectomy when the "combined operation" is chosen preliminary to the extraction of the cataract. I have no doubt that nearly all surgeons do preliminary iridectomy in certain cases of immature cataract in which it is desirable to expose clear lens at the periphery to afford better vision until the cataract reaches a suitable stage for removal, or in cases in which it is designed to hasten the opacification of the lens; also in cases in which the extraction is expected to present unusual difficulties, and in cases in which the patient has lost the vision of one eye.

I confess that I have not found the advantages in preliminary iridectomy to be all that the theoretical consideration of the subject has led me to expect. The ultimate results have not been sufficiently advantageous to induce me to extend greatly the application of this operation. In all cases in which there is no special indication for preliminary iridectomy, if the combined operation is decided on, the iridectomy immediately precedes the capsulotomy. An exhaustive discussion of this subject is purposely omitted.

IRIDECTOMY AT THE TIME OF THE EXTRACTION.

After the incision is made, the iris may prolapse into the wound, which condition is apt to occur if the aqueous humor escapes with a gush as the incision is finished, or it may retain its normal position, particularly when the aqueous is made to escape slowly. When a complete coloboma is contemplated, it is desirable to grasp the iris near the pupillary margin (the style of iris forceps is of no particular importance). The iris is then drawn gently out of the wound, and when the part seized is well out of the eye it is cut off close to the globe by one snip of the scissors.

Shall the iris be excised by cutting it in the plane of the iris or at right angles to this plane? (In the line of the incision or at right angles to the line of the incision?) If there is a conjunctival flap it is difficult to excise the piece of iris by cutting at right angles to its plane without engaging and excising part of the conjunctival flap. For this reason, it is better when a conjunctival flap has been made to excise the iris in the direction of its plane. If no conjunctival flap is present it makes no difference which procedure is chosen. The amount of iris excised can be regulated to suit the surgeon, whether he chooses one or the other method. It is thought that the columns of the coloboma are less liable to become engaged in the angles of the wound if the iris is excised at right angles with the course of the incision, but in reality there is little in this contention, particularly if the piece of iris is excised at one snip.

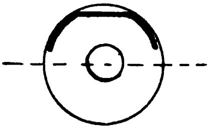

Fig. 22.—"Shoulder" incision.

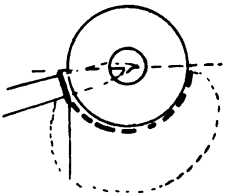

Fig. 23.—Czermak's incision.

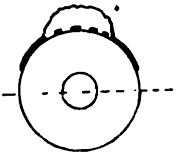

Fig. 24.—Incision practiced by the writer.

Should a large or a small part of the iris be excised? This is really of little importance aside from the question of appearance, provided the columns of the coloboma remain free from the wound. If the incision approaches the "linear" and extends into the sclera, the iridectomy should be large to provide against incarceration or prolapse of the iris; if in the limbus or in the cornea, the size of the iridectomy may be small without great risk of its becoming permanently engaged in the wound; if upward, it makes little difference whether the iridectomy be large or small, so far as the visual results are concerned. A small iridectomy gives a somewhat better cosmetic effect. Whether much or little of the sphincter iridis is removed is of small importance. If the iridectomy is small and but little of the pupillary margin of the iris removed, the amount of light entering the eye may be better controlled; however, it seldom happens that aphakic patients suffer from inability to control the amount of light that enters the eye, whatever the size of the iridectomy. The operator should free the wound from all incarceration of iris at the proper time of the operation, with the greatest care, using the spatula for this purpose.

COMPLICATIONS.

It sometimes happens that the iris is not readily grasped with the ordinary iris forceps. This is particularly apt to be the case if the iridectomy is not decided on until after the lens has been removed. Should this difficulty be experienced we may succeed by using forceps with the teeth placed on the lower edge of the blades near the tip of the blades, as in the Mathieu, the Smith, and the Knapp capsule forceps. If these do not succeed, the blunt or sharp-pointed Tyrell hook may be employed. If, after the lens has escaped, the pupillary margin of the iris above recedes beneath the cilary body (folds under), it is best not to attempt its removal.

If there has been an iritis and the iris is attached to the capsule of a cataractous lens, the ordinary iris forceps may not suffice to grasp the iris securely enough to bring it out of the wound. Strong forceps with teeth on the lower edge should be used in such cases.

ACCIDENTS.

(*a*) In drawing the iris from the anterior chamber the traction may be too great and the iris be partly or wholly torn from its attachment to the ciliary body (iridodialysis). If partial iridodialysis is produced the portion of the iris withdrawn from the eye should be excised. The iris that remains in the globe, even if detached from the ciliary body for a short distance, will give no trouble. After complete iridodialysis the patient will be annoyed by excess of light, but fair vision may be retained. (*b*) The capsule of the lens may be seized on attempting to seize the iris. This accident is of no particular importance.

Various forms of iridectomy and iridotomy have been employed by different operators from time to time with a view of simplifying the operation of extraction and of saving more of the iris. Daviel cut the iris from pupillary margin to the insertion of the iris (iridotomy) from time to time. Galezowski advocated iridotomy as a routine procedure.

Manolescu also divides the iris radially after having drawn it out of the eye. This, of course, subjects the iris to more or less bruising.

Chandler[35] advocates excising a piece of the iris near its insertion just after the lens has been removed in cataract extraction. The piece of iris removed is as nearly as possible 1 mm. in diameter. Operation is as follows: After the lens has been removed, before the cortical substance is removed, the iris is seized near its insertion by means of delicate forceps with the teeth placed at the ends of the blades. The seized portion of the iris is withdrawn from the wound and snipped off by means of thin-bladed scissors. Through the opening thus made, retained cortical lens substance is permitted to escape. The operation is termed the "modified simple" extraction. The operation was devised to avoid prolapse of the iris after simple extraction. Chandler reports 312 cases with 4 prolapses, 2 of which were the result of violence after the anterior chamber had been restored. Since the average of prolapse in simple extraction by good operators is approximately 6 per cent., the reduction by this method is very satisfactory.

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[35] Arch. of Ophth., xxxiii, No. 1, 1.

IMMEDIATE AFTER-TREATMENT OF CASES OPERATED ON FOR CATARACT (WITH BANDAGE).*

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CHICAGO.

The result of cataract operation is so frequently dependent on the skillful after-treatment of the case that the importance of this subject can not be overestimated. It is my purpose in considering it to limit whatever I have to say to the results I have had and the judgments I have formed from a fairly large experience, rather than to quote from literature the conclusions of others whose larger experience gives them claim to authority.

To begin, the after-treatment should be started before the operation by preparing the patient in much the same way as for operation under a general anesthetic. A thorough bath, shampoo of the head and cleansing of the face and field of operation are, of course, necessary, but, in addition to this, a complete emptying of the bowels by a good cathartic the night before and an enema on the morning of the operation is a practice that should be pursued in every case. This usually insures the bowels remaining closed for several days after the operation, which is desirable.

Patients who are restless or excitable, or who have an excessive nervous fear of the operation should receive a hypodermic injection of morphin, ¼ gr., together with 1/120 gr. of atropin about one hour before the extraction, unless for some reason it should be contraindicated.

The same remedy in smaller doses, or codein, may be administered some time after the operation if there is any excitability or tendency to coughing. This will aid also in keeping the bowels inactive for several days.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

The dressing used after the operation should be of such a kind that it will keep the eyes closed. Personally, I do not see the *rationale* of the treatment of leaving the eyes open after such an extensive injury of the cornea as that made in the incision for cataract extraction.

Furthermore, both eyes should be closed for a time, for if one is left uncovered and the patient looks around, as he certainly will do, the operated one will move under the dressing much more than it should. This is avoided by placing the dressing over both eyes.

The kind of dressing used varies according to individual preference, and there is no fixed rule about this, except that it should accomplish the purpose of keeping the eyelids closed without exerting undue pressure on the globe. My own practice is to place a couple of layers of thin gauze moistened with boric acid solution or sterilized water over the closed lids; on this the pads of absorbent cotton are carefully arranged so that there may be no difference of thickness to make unequal pressure, and then the bandage applied as a figure of eight over the eyes and around the head.

In this connection, and thinking it may not be known to all, I want to mention the value of the moist netting bandage used at the Illinois Eye and Ear Infirmary, and which, so far as I know, originated there. It is made of a fairly good quality of mosquito netting, cut into strips about three inches wide and four or five yards long, rolled, and then sterilized with dry heat. Just before use it is moistened and applied as a starch bandage. There is just enough sizing in the fabric to make the layers adhere when it dries, and yet it is not as cumbersome or as irritating as the ordinary starch bandage. It is lighter and will keep its place better than the gauze or muslin bandage. The edges on the cheeks, nose and forehead may be stuck down with collodion, after the manner of my colleague, Dr. Beard, to prevent the patient from inserting his fingers beneath the dressing. Further protection can be given by some form of shield, either the wire shield of Fuchs, or, better in my judgment, the light but firm mask of Ring.

If the operation has been done on a table or chair the patient is not allowed to walk to the ward, but is placed on a stretcher or ambulance and taken to his bed. If a folded sheet has been placed under him on the table he can easily be lifted by this from the table to the cart and from that to the bed without his making any exertion or being disturbed. He is cautioned to lie quietly in bed and not to disturb the dressings. The room should be darkened. If there is much restlessness sedatives may be given.

If the patient disregards the injunction to keep the hands away from the face, they must be tied with a bandage to the sides of the bed so that he can move them but can not reach his face. If there is any doubt about the patient's self-control this precautionary treatment should not be neglected. The patient should be enjoined to lie quietly in bed, and particularly not to move the head about. This is not an easy thing to do, and the nurse or attendant must be ready to relieve discomfort by shifting his position slightly or partially turning him and supporting him with pillows.

The dressing is changed on the next day after the operation, this being done with the patient in bed, and with antiseptic precautions. It is exposing the patient to a needless risk to have him brought to the surgical dressing room in a hospital, even if he is transported on a stretcher. The edges of the lids are gently wiped with pledgets of cotton moistened with boric acid solution or sterilized water. Unless there is some evidence of conjunctival secretion or edema of lids or some indication of prolapse of the iris, such as pain, the eye is not opened at the first dressing. Should there be a suspicion that all is not well the eye may be carefully opened, after cleansing the edges of the lids, and the wound inspected.

The conjunctival sac is not irrigated unless there is evidence of infection or an undue secretion of mucus. I have found it better to abstain from cleansing the conjunctiva with any solution unless there is a positive indication for it, such as would be given by considerable secretion. However. a drop of 1 per cent. atropin solution may be instilled at this time and also at each subsequent dressing. Both eyes are bandaged as at first and the protective shield replaced. Each day the eyes are dressed in the same way, and, barring complications, nothing more is done than to wipe the edges of the lids and the surrounding parts of the face with moistened gauze or cotton, instil atropin and apply the dressing to both eyes.

At the end of the fourth day, if all is well, the unoperated eye may be left uncovered and the patient allowed to sit up, at least for part of the time. If the bowels have not moved, and usually the treatment before the operation and the light diet for the first two days after keep them closed, a laxative or an enema may be used at this time to induce a free movement.

If, at the end of the fifth day, it is clear that the wound is firmly healed, the bandage is left off entirely and the eye is covered with a dark shield so constructed that it will not touch the eyelids but will protect the eye entirely from the light. Such a shield can be made by cutting the Ring mask in two, trimming it so that it fits the contour of the nose and cheek and sewing on tapes with which to hold it in place. Or a shield can be made of light pasteboard or cardboard, shaping it in such a way by cutting out a narrow wedge-shaped piece from the upper edge, that it will stand away from the eye, and then blackening or covering it with some dark fabric. The purpose of this protective shield is to avoid the irritation that comes from keeping the eyelids closed with the gauze and cotton dressing under a bandage, and, therefore, no dressing should be placed under this shield to interfere with the motions of the eyeball or lids.

I have observed that my patients recover with less reaction and have less discomfort with this dressing than with the bandage. Naturally it would not be used until one was reasonably sure that there had been firm union of the wound. If there is no great reaction at the end of ten days the patient is allowed to accustom the eye to the light by taking off the shade for short intervals, and usually at the end of two or two and a half weeks he is ready for the discission of the capsule.

GENERAL TREATMENT, DIET, ETC.

As stated in the beginning, I think cataract cases should be prepared as for an operation of greater magnitude under narcosis. If the bowels are thoroughly emptied prior to the operation, and a light diet given for two days after, there is less danger of toxic substances absorbed from the intestines affecting the healing of the wound. Furthermore, the resulting constipation, which may even be favored in certain cases by hypodermic injection of morphin, is an advantage because many of these patients use the bed pan with difficulty, and any attempt to have them sit up may jeopardize the prompt healing of the wound.

By light diet I mean milk, weak broths, toasted bread or crackers, custards, certain cooked fruits—such as apples or peaches, and in rather small quantities; in other words, easily digested foods that leave very little residue. At the end of the second day full diet is usually allowed.

GENERAL COMPLICATIONS.

Many elderly people have bladder disturbances and can not void the urine while lying down. In the case of men this is frequently due to stricture of the urethra or the enlargement of the prostate, while in both sexes a spasm of the sphincter may prevent it. Such patients will probably require catheterization, and the physician should be prepared for it and instruct the nurse accordingly, so that for the first two days at least, the patient would not have to even turn on his side. In case of a difficult stricture it might be necessary to aspirate the bladder.

As said before, constipation, at least for a few days, is rather to be desired than dreaded. If the patient has not had a natural movement by the fourth day a laxative or an enema should be given, and after he is sitting up it is important that the bowels should move regularly. After the period of enforced constipation there may be irregularity, but this should, if possible, be corrected by diet and proper treatment.

Mania.—It should not be forgotten that in some elderly people there is a disposition to great mental excitability or even mania when both eyes are closed with a bandage. Many of the old people are childish, and, finding themselves in the dark and unable to see anything, are seized with terror or dread that is uncontrollable. The physician or attendant should be on his guard concerning this, for the patient might get out of bed and spoil the eye. In such cases it may be necessary to reassure the patient by removing the dressing from the sound eye, or he may have to be quieted with sedatives or hypnotics. I prefer to try this latter measure first, but frequently they are more quickly and effectively pacified by uncovering the healthy eye, and it may be better to do this than to run the risk of the other being injured by attempts to get out of bed.

Vomiting and Indigestion.—If the case has required a general anesthetic the vomiting after the operation may be annoying. Previous general preparation of the patient will do much to prevent this, but it should be checked as quickly as possible, if necessary with sedatives, so as not to jeopardize the eye which has been operated on.

Cough.—Cough is to be dreaded and should be promptly controlled for fear the wound will be opened by violent efforts. For this reason if the patient has a bronchitis or a considerable cough from any cause it would be best to postpone the operation until the diseased condition is relieved. If, however, after the operation the patient develops a cough, every reasonable effort should be made to relieve it. If the trouble is pharyngeal or laryngeal, sedative sprays may do good, sipping ice water or eating shaved ice will help. Bronchial cough may be controlled by heroin, codein, or, even if necessary, hypodermic injections of small doses of morphin until the patient has been tided over two or three days, when probably the wound will have healed.

LOCAL COMPLICATIONS.

Leakage of the Wound.—If the lips of the wound are not perfectly coapted the aqueous humor may drain away and the anterior chamber not reform for several days. This should be looked for at the first inspection of the eye, and if the anterior chamber appears shallow the eye should be dressed with the utmost care, so that there will be just enough pressure on the globe to insure immobility. The patient should also be cautioned against making any movement for fear of opening the wound. Such a condition would naturally delay the time when it would be safe to allow the patient to sit up.

Prolapse of the Iris.—This usually occurs as the result of some movement on the part of the patient or from coughing, sneezing or pressure on the eye. It is favored, of course, by an imperfectly coapted wound, and so might occur more readily after a faulty technic. It usually announces itself by more or less pain, which, if at all marked, is strong enough evidence to indicate immediate removal of the dressing. Sometimes, however, there is not much complaint of pain, and the prolapse is not discovered until the next regular dressing of the case. The sooner it is discovered the better. If the accident is very recent and the prolapse is slight, an attempt may be made, after thorough cocainization of the eye, to gently replace the prolapsed iris, but in most cases this will be unsuccessful and it must be excised. In doing this care should be taken to gently free the iris at the angles of the wound, so that when the prolapsed portion is excised, the rest will draw back into the anterior chamber. This may be facilitated by gently stroking the wound with a spatula. After cleansing the wound with mild irrigation, the dressing is reapplied and additional precaution taken to prevent a recurrence of the accident.

If prolapse occurs after an extraction by either the simple or combined method made with a large conjunctival flap, we frequently find that the conjunctival wound has held perfectly and the prolapsed iris is covered by the conjunctiva. If in such a case the knuckle of incarcerated iris is small I prefer to leave it rather than to remove its covering of conjunctiva and excise it, and so expose the eye to the additional risk of infection. A slight additional pressure of the bandage and dressing may help it to heal firmly.

An incarceration of the iris in a part of the wound without a prolapse would be treated similarly. In all cases of this kind, if seen recently, an attempt may be made to draw the iris away from the wound by eserin, but the continued use of this drug should not be practiced because of its liability in such cases to excite iritis.

Hemorrhage.—Hemorrhage into the anterior chamber or vitreous, either with or without partial opening of the wound, is a serious complication. It is usually the result of some trauma, but it may occur in persons with high arterial tension in whom the arteries of the eye are frail, and in such persons it may occur spontaneously or may be brought on by coughing, sneezing or straining at stool. If a thorough examination of the heart, arteries and kidneys is made prior to the operation the surgeon will be on his guard if a high arterial tension is present and there is evidence of hardened or rigid vessels.

In the treatment of this complication, additional precaution will be taken to keep the patient quiet and arterial tension will be lowered by nitroglycerin or other arterial sedatives, measures to promote flow of blood to the extremities and leeches to the temple to prevent further hemorrhage. The absorption of the blood in the eye should be encouraged by pilocarpin sweats, dionin and hot applications, although the latter should be used with great caution in these cases.

Infection.—Infection of the wound is the worst complication that can befall a cataract case, for unless promptly checked it is almost certain to result in loss of the eyeball or, failing this, in a plastic iridocyclitis that will obliterate vision. A suspicious grayness of the edge of the corneal flap is the first sign noticed, and usually by the second day this increases and the wound begins to gap. Chemosis and hypopyon appear. In the secretion from the conjunctiva, which may be scanty or considerable, one may usually but not always find germs of a virulent type, such as pneumococcus or some of the pus formers.

At the first sign of infection vigorous general and local treatment should be instituted. A brisk cathartic with calomel should be given. Liberal but easily digested food should be allowed, and such tonics or stimulants as will improve the general tone and increase the vital resistance should be prescribed. Quinin, strychnin and small doses of whisky might be mentioned.

Irrigation of the eye every few hours with boric acid solution or bichlorid of mercury solution, 1/6000, should be practiced. One should not neglect the cleansing of the lachrymal sac, particularly if there is any evidence of retained secretion there. Subconjunctival injections of physiologic salt solution or cyanid of mercury solution, 1/1000, may be tried. Hot applications, continued for fifteen or twenty minutes, should be applied three times a day. Local blood letting, by natural or artificial leeches applied to the temple, may be of some benefit.

In spite of all such measures, if the infection is a virulent one or the vital resistance is much lowered, the eye almost certainly will be lost and the question of evisceration or enucleation will come up.

Iridocyclitis.—The reaction that follows after cataract extraction is not always easy to explain. In some cases, where the operation has been done exceptionally well and every precaution used in the treatment, severe reaction will follow, while in others, in spite of accidents and complications, there will be so little disturbance as to be surprising to the surgeon. I am sure that I formerly had more reaction than was necessary by too zealously treating the eye with irrigation or continuing the bandaging for too long a time. Too early an exposure to the light is wrong and probably accounts for some of the cases of prolonged irritation and iridocyclitis.

But in addition to these more apparent reasons, such as local irritation of the eye of any kind, there must be some deeper underlying cause, which I am inclined to believe is of a toxic nature. This, acting on an eye whose resistance is more or less affected by the injury of an operation, in certain cases with a predisposition to uveitis, or in others already having uveal changes, might cause a severe irritation or even an iridocyclitis of a plastic nature.

In such cases the signs would vary from slight sensitiveness to light and lachrymation up to a severe reaction with ciliary pain and considerable plastic exudate. In these cases I have come to place considerable reliance on the administration of salicylic acid as proposed by Gifford, and I know of nothing that will more quickly influence the condition than large doses of this remedy, 20 grains of salicylate of soda every three hours.

In addition to this, active elimination by means of cathartics and diuretics is valuable, and in some cases I have had good results from the use of pilocarpin sweats, administering hypodermically 1/12 gr. of pilocarpin muriate at the time of the preparation of the patient for the sweat. Locally, hot applications, dionin, and subconjunctival injections of salt will tend to stimulate circulation in the inflamed eye and help to eliminate the toxic elements, whatever these may be.

The continuous use of atropin, in cases where there is unyielding adhesion of the iris to the capsule, will frequently keep up ciliary injection because of the dragging on the synechiæ. The division of the bands that prevent the free dilatation of the pupil and the free action of the iris will often correct this condition.

Vitreous Opacities.—In cases such as we have been considering, where there has been considerable reaction, one usually finds, on examination, evidences of the inflammation and of the causes that have brought it about, in the shape of vitreous opacities which more or less obscure the vision even after the needling. Among the different means for causing absorption of these I have found syrup of hydriodic acid in one-dram doses three times daily one of the most efficient and most easily tolerated of the iodin preparations.

In conclusion, much of the success in the management of the cataract case will depend on the skillful after-treatment, and of this too great emphasis can not be placed on the importance of general conditions and their appropriate treatment. Furthermore, much will depend on the previous preparation of the case to prevent both local and general complications. While every precaution should be taken and every possible care bestowed on the numerous details in the management of the case, it should be remembered that too much zeal in local applications may sometimes lead one into error.

THE IMMEDIATE AFTER TREATMENT OF CATARACT OPERATIONS (WITHOUT BANDAGE).*

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PINE BLUFF, ARK.

In view of the fact that the postoperative treatment of cataract cases depends to some extent on the technic of the operation, I consider that it will not be amiss to review briefly the technic, or rather a certain feature of the technic, which appeals to me as being most rational, and which in my hands has stood the test of experimentation. The point to which I refer is the construction of an ample conjunctival flap as the knife emerges from the incision, the employment of which seems to produce the most rapid resolution and recovery, minimizes the risk of infection, and at the same time obtains the best possible vision and the greatest comfort to patients during convalescence.

The great fundamental proposition which confronts the ophthalmic surgeon in the treatment of every cataract operation is how he may best prevent infection. This may be reduced to a minimim by a strict observance of the aseptic means at our disposal, with or without a bandage. It is a well-known fact that when the flap is employed the mucous membrane will reattach itself, under favorable conditions, in only a few hours, and it is also a logical deduction that a prompt reattachment is the most important requisite for producing aseptic healing. Since pathogenic bacteria have been proven to exist normally in the cul-de-sac, the secretions of the conjunctival sac being a culture medium for bacteria, and there being no effective means at our disposal by which we may rid the sac of these bacteria, it naturally follows that the prompter the union the less the risk of infection. The question whether or not we shall employ a bandage and at the same time be able to protect the eye from external injury during the after treatment of these cases, is one which has been agitating the minds of a few ophthalmic surgeons for some time. Suffice it to say that the majority of surgeons still adhere to the use of the bandage. I have long since discarded the bandage, save in exceptional cases in which there may be something out of the ordinary to demand it.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

Why should we advise the non-use of the bandage? There are five essential reasons:

First.—The bandage interferes with natural drainage and brings about a retention of secretions which is to be avoided.

Second.—The bandage interferes with uniform pressure on the wound and ball of the eye, such as would be maintained by the natural position of the lid itself.

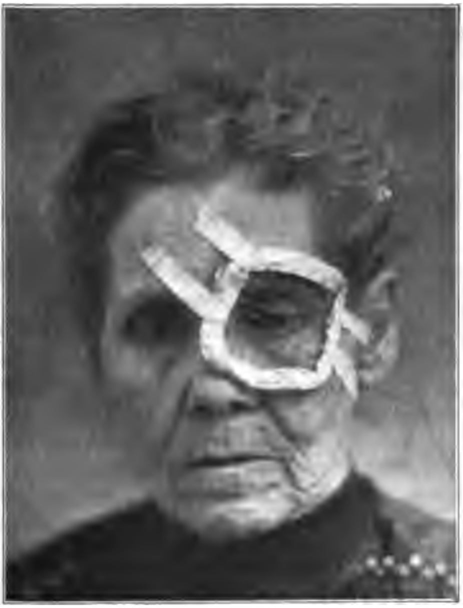
Third.—It creates a feeling of discomfort and restlessness, which interferes with the healing process in that it increases the involuntary mobility of the eye.

Fourth.—It is a factor in producing entropion of the lower lid, which in many cases is exceedingly difficult to avoid.

Fifth.—It is a factor in producing conjunctivitis, iritis and cyclitis, which will be shown later.

The necessity of bandaging is obviated by the use of a wire screen. This screen is constructed before the operation and made to conform to the bridge of the nose, the brow, the temporal and malar processes. It consists of a wire hoop rather quadrangular in shape and is bridged across with numerous wires forming meshes not large enough to admit the patient's fingers. The rim is cushioned on the proximal side with gauze to add to its comfort. The screen is bent into a concave shape that it may be amply out of the way of the lids and lashes. In adjusting it, it may be held in place by strips of adhesive plaster or by strips of gauze tied at the occiput. After the operation is completed the flap is smoothed into apposition, the retractors are removed and the lid is allowed to ease into its natural position. If we feel that the lid may not have fully recovered from the influence of the retractors, and that the lips of the wound may have been disarranged thereby, after a few moments the lid is gently raised to see that apposition is maintained. A single or double layer of moist bichlorid gauze is then placed over the eye and the screen adjusted. After six hours we have a right to presume that union is well established, so at this juncture the gauze is removed and the screen readjusted.

I allow my patients to sit up throughout their convalescence; the recumbent posture is conducive to a state of nervous restlessness, to say nothing of more aggravated symptoms, all of which concur to interfere with uneventful healing. These patients are more submissive and quiet when they are permitted to sit in a comfortable chair; however, they are forbidden to walk unguarded around the room for the first and second days.



Method of using screen after cataract operation.

This feature in the management of the convalescent stage is especially advantageous in those patients who, in a state of senility, are predisposed to hypostatic congestion of the lungs during rest in recumbent position, or what is equally as frequent, to chronic bronchial catarrh with cough, or to some bladder trouble.

Again, not infrequently we are confronted on the second or third day or later with the onset of iritis or cyclitis. Whether these complications are due to some nonpyogenic bacteria which have entered into the eye during or after the operation or to a chemical irritation, or what is more probable to the iris being encroached on by the jagged edges of the capsule or by some unremoved particles of lens substance, it matters not. As the eye is not a perfect sphere, being longer in its anteroposterior axis than any other, it is impossible for a bandage to be applied, no matter how carefully, so that it will not disturb the relation of the iris with that of the edges of the capsule or with some particles of the lens substance which may have been left, so long as the eye is permitted to move from one position to another. Certainly a mechanical irritation is more liable to set up under the constant disturbance of such relations than while the eye is undisturbed in its position under the natural influence of the lid only. In my experience the unbandaged freedom of the eye has seemed decidedly to hasten recovery and to minimize the complications.

In conclusion, I will relate briefly the history of one case, which will illustrate the treatment and the results which may be obtained by adopting the methods outlined in this paper. 'The deduction and conclusion at which I have arrived were not based alone on my own cases (except that of allowing the patient the pleasure of sitting up if desired), but on an ample observation while attending Professor Sattler's clinic at Leipsic in 1902; having obtained like results in seventy cases in my own practice subsequently, I have become a staunch advocate of the method here outlined.

A patient, aged 64, was operated on at 10 a. m. January 12. An iridectomy and also a conjunctival flap about 2 mm. in length was made, a double layer of wet bichlorid gauze was placed on the lid and the wire screen applied as shown in the accompanying illustration. At 6 p. m. I removed the dressing, instilled one drop of atropin and readjusted the screen, leaving off the gauze. The patient was put to bed. At 9 a. m. the next day the patient was allowed to sit up in a reclining chair as on the previous afternoon. On the third day the patient was allowed to move about in the room, the fourth day to walk about in the house, the fifth day to return home, seventy-five miles away. After five weeks the patient returned for refraction. Vision = 20/27. In two months vision = 20/25.

It is important to use a drop of atropin when first examining the eye after the operation. Every one who employs a bandage will admit that the early use of atropin is justifiable on account of the frequent occurrence of an iritis, for it is important to obtain a dilated pupil before redness of the eye takes place, or before any adhesions between the iris and the capsule, which, when set up, is often of from two to four weeks duration. These complications tend to produce an exudation which interferes with good vision, and are aggravated, if not produced, by the constantly disturbed relation of the iris with its adjacent parts during the movement of the eye when bandaged. If the eye is left protected by the lid and screen only, and atropin is used when the patient is first seen after the operation, such complications do not often occur, and if they do are very slight.

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OPERATIONS FOR SECONDARY CATARACT.*

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NEW YORK CITY.

The ideally perfect cataract extraction should consist of a method involving a minimum of risk, without sequelæ demanding subsequent interference to obtain good vision.

The extraction of the opaque lens within its capsule appeals to us all, but the consensus of opinion regards this operation as not safe as a routine method. Most ophthalmic surgeons extract cataracts without the capsule, leaving the latter to cause subsequent operative measures necessary in the majority of cases.

Various capsular forceps have been devised to obviate the formation of secondary cataracts. With the forceps the attempt is made to remove the anterior capsule within the area of the pupil, so as to secure a clear opening after the removal of the opaque lens. I have never been able to satisfy myself that the forceps had rendered subsequent secondary cataracts less numerous than when the cystotome had been used, but this may have been the fault of the operator. The percentage of secondary operations varies with the education and calling of the patients.

Taking the statistics of cataract extractions done in different ophthalmic hospitals for a given year, and the secondary operations done within the same period, it will be found that 50 per cent. require subsequent interference in order to get good vision. The majority of these patients are of the laboring class, who do not need very acute vision, so that if the statistics were gathered from an educated, intelligent class the percentage would be 75 per cent. The most expert operator, no matter how perfect the technic, using capsular forceps and washing out the débris, can not avoid secondary cataracts in the majority of his operations.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session. June 4-7, 1907. Publication rights reserved by the American Medical Association.

Secondary membranes or cataracts may be divided into simple and complicated. The former consists of a thin, diaphanous veil, which, owing to folds or rumpling of the anterior capsule, seriously interferes with good vision. The latter varies in degree from an opaque membrane within the pupillary area to the most dense mass which shuts off all communication between the chambers. The density of the membranes depends on the cortical lens matter left after the extraction, the cellular proliferation of the anterior capsule and the inflammatory deposit due to iritis, etc. In the complicated cases, we must add incarceration, prolapse of the iris and considerable loss of vitreous humor.

A secondary operation should not be performed until the eye has fully recovered from the effects of the cataract extraction. When the extraction has been performed *secùndum artem,* with uneventful healing and no sequelæa, a period of six weeks is quite long enough to elapse prior to further interference, when necessary. Not infrequently conditions are encountered in which the eye does not become perfectly free from inflammation and interference becomes imperative where delay would mean disaster. Dense exudate resulting from protracted iritis, completely occluding the pupil, preventing all communication between the chambers of the eye and extensive incarceration (or prolapse of iris) call for surgical relief. Otherwise the eye goes on to disintegration. Such conditions keep up the inflammatory process and the surgeon is forced to interfere sooner than would ordinarily appear justifiable. Operating under these conditions does not always give a permanent opening, but, even so, the traction on the iris is removed and some communication is secured between the two chambers, so that after complete quiescence does take place some visual power may be obtained by further operative measures.

There are three sources of danger in operating on secondary cataracts, as follows:

1. Infection.
2. Traumatism.
3. Relighting inflammation due to the extraction.

To my mind, the danger of infection is the least formidable of the three, provided the usual necessary aseptic technic is carefully observed.

Traumatism is usually due to the choice of the wrong procedure in securing an opening through the obstructing membrane. The objective point is a clear pupillary opening, and to secure this no method ought to be employed that simply depends on tearing. I firmly believe that most of our disasters following secondary operations are due to traumatism resulting from improper methods. We should never attempt to tear dense or tough obstructing membranes. Always cut them, inasmuch as the tearing means traction on the iris and ciliary processes, with glaucoma, or iridocyclitis, or panophthalmitis, as a result.

The chief danger is due to overhaste in operating before the eye has fully recovered from the effects of the cataract extraction. The eye is in the state of passive congestion and it takes but little to relight an active inflammatory process.

Not infrequently the surgeon is importuned by the patient to operate soon after the cataract extraction—he lives at a distance—he must return to work—he is anxious to see, etc. Further, as time goes on, the secondary membrane often becomes more dense. However, experience teaches us the wisdom of being patient until there is but little chance of reaction following the second operation, provided the correct method is chosen.

Chiselden was the first to make an artificial pupil, about 1728. He introduced a knife needle on the temporal side one and one-half lines from the clear cornea into the posterior chambers, pushed the point through the iris about one line to the outer side of pupil, carried the knife across the anterior chamber to inner angle and cut through iris to the original point of cutting, a sufficient distance to secure an opening. The iris on temporal side was permitted to remain intact up to the point of the knife-needle entrance into anterior chamber. This was done in cases of occluded pupil, following couching operations.

Gendron performed a corneal incision, having observed that a single line cut was not enough for visual purposes.

Baron Wenzel performed, instead of the straight-line incision, a flap, and removed a small piece of iris. To do this he introduced a pair of scissors into the anterior chamber.

Scarpa did an iridodialysis, and removed by cutting or tearing any capsular membrane within the area of the opening.

Professor Maunoir, of Geneva, in 1802, performed the first iridotomy. He used scissors with cutting blades fifteen to eighteen mm. long, one blade probe-pointed and the other sharp-pointed. The blades were bent forward near the joint 140 degrees. The closed scissors were entered through a corneal opening into the anterior chamber. They were then opened and slightly tilted with the sharp blade below. Then this was pushed through a suitable place in the iris tissue and the cut or cuts made as desired.

Various operators during the last century devised knife needles to operate on secondary membranes.

Bowman's method consists in the use of two needles and does not depend on cutting—it simply tears.

De Wecker. in 1873, devised his pince ciseaux, which is practically Maunoir's idea, only seventy years later.

At present there are three methods generally used in performing secondary cataracts, as follows:

The knife needle, preferably Knapp's, for thin membranes.

The narrow Graefe cataract knife for thick bands or dense pupillary deposits.

The forceps scissors for all cases when the knife is likely to cause dangerous traction.

The choice of an operative procedure must be entirely guided by the characteristics of the obstructing membrane. In dealing with a thin, diaphanous membrane —which, owing to wrinkled, crumpled or pleated surface, does not give satisfactory vision—we choose a knife needle and perform a discission. The knife needle must have a slight taper of the shank toward the handle to prevent the escape of aqueous; the cutting edge should have a convex surface six mm. long and not to exceed one mm. in breadth. The pupil ought to be fully dilated and the membrane cut within its area.

Enter the cornea at the upper or outer limbus with the needle and, as T-shaped incisions are to be made, cut the membrane entirely across its upper third. Then carry the needle down to the lowest margin of the pupil and cut upward to the center of the first incision. Two cuts are made—the first in the horizontal. the second in the vertical plane. If a conical form of opening is preferred the two incisions make a right angle at the center of the proposed pupil.

Frequently a tough or resilient band prevents either one of these discissions in the manner indicated. No attempt should be made to cut these obstructing bands with the knife needle, for they do not cut without exerting a dangerous amount of force on the iris and ciliary processes. Make the incisions in the point of the thin, clear membrane giving the largest clear surface.

It has been my fortune to have seen five cases where these tough, resilient bands caused glaucoma. Four of these cases were in my own practice. On two of them I had operated for cataracts and performed secondary operations and avoided cutting the tough bands. The first case became blind from glaucoma at the end of the second year following the last operation. The second had good sight for four and a half years, when she returned with a subacute attack of glaucoma, which lasted two months. A free division of the band saved some sight. The third case was a needling of the right lens done in Russia to enable the young man to escape military duty. I saw him eighteen months after the needling and, as he did not wish to have any operation performed, nothing was done until two years later, when I found the eye blind T + 2—simple glaucoma. The fourth case was that of a young boy with a traumatic cataract, where four years after the injury the lens had absorbed and an attack of acute glaucoma set in. Another ophthalmic surgeon made an iridectomy upward, but this did not stop the process until I cut freely a tough, broad band that was exposed by the upward iridectomy. The fifth was Dr. Dwight Hunter's case, in which some months following a successful cataract operation the patient returned to the doctor with an acute attack of glaucoma, which rapidly disappeared after a broad band, which was stretched across the pupil, was severed by Dr. Hunter.

The full extent of the thickened capsular bands is very difficult to determine. Owing to iritic adhesions, full mydriasis is not possible. In none of these cases, however, was there either incarceration or prolapse of capsule, lens or iris, as far as I could see.

Looking this matter up I find that Priestley Smith has referred to a case in which a band from corneal cicatrix to ciliary processes caused glaucoma.

In my first two cases of glaucoma caused by capsular bands I failed to recognize the connection, but within a very short interval the third case presented in which an iridectomy had been made without benefit. The iridectomy showed a broad capsular band indicating evident tension, but in cutting this the severed ends immediately sprang apart. In other words, the conclusion was forced on me by the third case that the overlooked, apparently trivial, thickened capsule was the cause. How many of my previous cases of glaucoma were similarly caused I can not tell.

Bowman's method of operating on dense capsular membranes consisted in the use of two needles. The cornea is penetrated in the vertical or horizontal plane at the outer and inner third of its diameter. The point of each needle is gently pushed through the center of the proposed opening in the capsular mass. Then the handle of each needle is elevated and slowly approximated, splitting the thickened membrane. The immediate result is a vertical or horizontal opening through the secondary cataract, which subsequently is apt to become small. This operation by many authors is considered quite safe. They base their approval on the fact that by the use of the two needles the traction on the iris and ciliary processes is removed. This I deny, inasmuch as the operation is essentially a tear with the pull in the line of cleavage. The tougher the membrane the greater the pull on the iris, etc., exerted at right angles to the movement of the plane of the needles. In other words, to split the secondary cataract as the needle's points are separated, the opening is made at the expense of traction in the line of cleavage on the ciliary processes.

There is another method of operating on these dense secondary cataracts which is advocated at the present time by a number of able ophthalmic surgeons.

The cornea is penetrated near the limbus with a thin Graefe cataract knife, the cutting edge of which is directed to the iris and carried across the anterior chamber to the nasal side. The knife point is pushed through the iris into the vitreous humor and the iris and secondary membrane are cut toward the temporal side. In cutting an opening the knife handle must be elevated and the back of the blade is held in close contact with the cornea opening, which is to act as a fulcrum and prevent the escape of aqueous. The movement is of two kinds—either a sawing motion going more or less deeply into the vitreous, or a drawing of the cutting edge against the membrane. The thick dense membrane requires a sawing motion to cut an opening.

When there is a dilated pupil the iris is not cut, or in severing tough resilient bands across an otherwise gauze-like membrane the cutting is entirely confined to the secondary cataract. In many instances the pupil is too small and bound down, so that it is necessary to include the iris in the section, otherwise the opening will be too small. In performing this operation only one incision can be made at a sitting, and in case that cut does not retract its opening will not suffice and a second attempt must be made at some future time. The second incisions must be placed at right angles to the first in order to obtain a sufficient aperture. This operation is not entirely free from danger, due to the traction in cutting through the tough membrane.

Bearing in mind that all traction is to be avoided in cutting through secondary membranes, I know of no method quite so satisfactory in complicated cases as an iridotomy done with the forceps scissors. For the correct performance of this operation two instruments are essential—a narrow, bent keratome (Agnew's) and a forceps scissors. With the keratome an opening is made through the cornea and secondary cataract. The location of the corneal opening depends in the main on the iris. With a mobile intact iris it is necessary to make the corneal incisions 3 to 4 mm. from the limbus. This is especially the case in the young, as the iris quickly contracts after the withdrawal of the keratome and the loss of aqueous humor.

If an iridectomy was done at the time of the extraction the corneal opening may be placed at the limbus. In other words, the corneal opening should be so placel that after the scissors have passed through it into the anterior chamber they may be freely used without the heel of the scissors unnecessarily wounding the iris.

In operating with the scissors when there is a band or bands covering an otherwise gauze-like membrane dilate the pupils ad maximum. Cut the cornea with bent keratome 4 mm. from limbus, carrying the point through the thin secondary membrane 15 degrees below corneal section into vitreous humor. Move the point from side to side so as to enlarge the opening in membrane. Withdraw keratome and insert closed scissors into anterior chambers. Slightly tilt the blades and insert one behind the band or bands to be severed, and the scissors should be carried down to the lowest margin of the proposed pupil. The incisions do not include any iris tissue, but are confined to the secondary cataract within the area of the dilated pupil. It is well to bear in mind that the more extensive the incisions are made the greater the central aperture, which should be V-shaped. In case we have to deal with secondary cataracts complicated with extensive iritic adhesions where the pupil is contracted or occluded the iris tissue must be included in the incisions, otherwise there will not be secured an adequate opening for visual purposes. Place the corneal opening at upper limbus, incise iris as near the corneal incision as possible for free working of the forceps scissors within the anterior chamber. The iris opening should be enlarged laterally 5 mm., either by keratome or scissors. Then with forceps scissors cut downward from middle of iris opening until the lowest border of sphincter is included. It is usually necessary to include the sphincter below the incision, otherwise the V-shaped opening is not large enough to serve as a permanent pupil.

In dealing with incarcerations or prolapse of iris the lateral incisions must be made with the forceps scissors and carried to inner and outer angles so as to free the iris from all traction. The downward vertical cut must be carried far enough through the sphincter and iris tissue to place the opening in normal position of pupil.

CONCLUSIONS.

Secondary membranes, consisting of capsule, gauze-like in texture, readily yield to a discission performed with the knife needle under artificial illumination.

Thin secondary membranes, consisting of one or more bands, require different handling. Simply avoiding these bands in performing a discission with the knife needle is a conservative course that gives a good visual result, followed, however. in some cases by subsequent disaster, due to the traction of the bands on ciliary processes.

Tough resilient bands can be disposed of successfully by the expert use of the thin Graefe knife in one operation by cutting at a right angle to their long axes. Thick, dense secondary membranes within the area of a fairly large pupil can be disposed of by the use of a Graefe knife in two operations, although I do not consider this the best course to pursue.

Bowman's two-needle operation for similar conditions, viz., dense. opaque membranes, covering a fairly large operation field, is mentioned merely to deprecate its use. The essential features of the method depends on tearing the dense membranes.

Judging by my experience in handling all forms of secondary cataracts, other than the thin diaphanous membranes, the forceps scissors affords the safest and most reliable of all instruments. By a judicious use of the De Wecker scissors the toughest membrane can be cut without any traction either on iris tissue or ciliary processes. In all complicated forms of secondary cataracts, occluded pupil, incarceration or prolapse of iris, it is the only instrument of which a proper use combines a minimum of risk with a maximum of benefit.

Do not tear secondary cataracts. Always cut them.

Disasters following secondary operations are in the main due to tearing methods in operating. The least danger is from infection.

DOES THE OPACITY OF INCIPIENT CATARACT EVER REGAIN TRANSPARENCY?*

LEARTUS CONNOR, A.B., M.D.
DETROIT.

Our problem is not the mere restoration of vision in a cataractous eye, as this may occur from absorption of the cortex or in traumatic opacity; nor is it the clearing of a diffuse cloudiness of the lens, as this has been observed to follow correction of eyestrain. It is rather the partial or complete transformation of opaque striæ with diffuse opacity into clear lens. Such opacities are seen in the lenses of individuals past middle life, and in some cases are associated with such general diseases as diabetes, Bright's disease, syphilis, and arteriosclerosis; some with uncorrected refractive defects, and others with as yet undefined conditions.

Progress, in the non-surgical management of incipient cataract, calls for the settlement of two questions:

First. Do the opaque striæ of incipient cataract ever become transformed into transparent lens?

Second. What are the conditions under which transformation occurs?

If the striated opacity of incipient cataract ever becomes transparent it will do so again under the same conditions and a basis be established for intelligent management of such cases. As yet we know little of the conditions associated with the development of senile cataract and less still of those attending its transformation into clear lens; both conditions are closely related to lens nutrition, and may be either within the eye or outside. Those within, like chorioiditis, may defile the lymph by which the lens is nourished, or disturb the action of capsule cells or lens fibers; or derange the intraocular circulation of blood and lymph. Those without either disturb the quality or quantity of blood and lymph currents to and from the eyeball, or the innervation, as in diabetes, renal disease, and arteriosclerosis. In the cases reported, attention was constantly given to the study of these etiologic factors and best results were noted in the replies of such correspondents as worked along similar lines.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

Dr. S. D. Risley's papers in the *University Medical Magazine,* 1889, and Transactions of this Section in 1891, clearly show the close association of incipient cataract with a low grade of choroiditis and refractive defects. The correction of the latter markedly relieved the intraocular and extraocular disturbances save the lens striæ. Hence, Dr. Risley proved that in some cases eyestrain caused chorioiditis, and this in turn incipient cataract; a most helpful generalization. But the striæ still remained. Can nothing be done for them in their early incipiency? Must they continue to multiply till the changes in the lens permit of extraction?

These queries led me to note the lens appearance in incipient cataract with more care than formerly and to add, to the word record, coarse diagrams of the lens striæ, their position, length, number, relationship to each other, diffuse opacity, dots, etc.

These records, taken at intervals of months or years, made evident any considerable change in the striæ and their relationships. After a time I observed a diminution of stria and finally it faded away, a most unexpected phenomena. What I had previously regarded as impossible had actually taken place under circumstances that precluded doubt.

Later a similar change was noted in another case and another till the list increased to six, brief abstracts of which are given, so far as related to the question before us.

To this list I have added a case of diabetic cataract, because the physician who first saw it said that it exhibited the striated form of incipient cataract, though the striæ were obliterated before the patient came under my observation. In these abstracts of cases the time limit compels the omission of all history of clinical conditions under which the lens capacity developed or the changed conditions under which the lens regained transparency.

Case 1.—Mrs. R. M., Adrian, Mich., a widow, aged 50, was referred to me by Dr. J. H. Reynolds for defective vision on Feb. 10, 1891. She was fleshy, of a nervous temperament and troubled with indefinite intestinal disorders. She complained of smarting, blurring and itching on using her eyes. Moderate blepharitis and conjunctivitis were present.

Treatment.—Ophthalmoscopic examination was negative except for the usual appearances of hyperopia. Vision of each eye was 8/200 increased to 20/30 by plus D. 2.00 S.; and Jaeger I. with plus D. 5.50 s. in right and plus D. 6.00 s. in left eye.

Subsequent History.—On Oct. 17, 1896, she returned saying that recently the old discomfort in her eyes had returned. Her vision was 10/200 in each eye increased to 20/30 by plus D. 3.50 S.; and Jaeger I. by plus D. 6.50 S. in each eye.

Oct. 13, 1905: Nine years after the previous visit, she again returned complaining of eye distress and saying that it had existed several months. His vision was now 12/200 in each eye increased to 20/30 by plus D. 4.50 S. in right and plus D. 4.00 S. in left eye. A new feature presented itself by oblique illumination and ophthalmoscopic study, viz., dark striæ in each lens. In the right lens they reached from the inner border almost across the pupil area; the left lens presented two similar striæ in the corresponding position. All striæ were shaded into clear lens by translucent opacity. Diagrams were made of these striæ as well as word description.

Oct. 4, 1906: Nearly one year later, no trace of these striæ could be detected by either the ophthalmoscope or oblique illumination. The regaining of transparency by the lenses had been perfect. Her vision was now 20/200 with either eye; increased to 20/20 by glasses ordered in 1905, Jaeger I. was easily read by reading glasses of the previous year. During the fifteen years she was under observation vision increased from 8/200 to 20/200; with correcting glasses from 20/30 to 20/20. This latter change occurred during the year in which the striæ vanished.

Thus the net result was the yielding of lens striæ in both lenses to transparency and the gaining of normal vision for distance, as well as in reading, by proper glasses.

Case 2.—Mrs. D. C., aged 60, was first seen June 20, 1898, for failing vision. She was a widow, fleshy and a chronic sufferer from so-called rheumatism and intestinal disorder. Vision of each eye was 20/200, increased to 20/50 by plus D. 1.50 S.; Jaeger I. with plus D. 3.50 S.

Examination.—Ophthalmoscopic examination showed a dark stria quite crossing the right lens almost vertically and seven shorter striæ extending from the lower and inner border of the lens almost to its center. In the left lens was seen a large stria extending from upper to lower border of the lens slightly inclined from the vertical, and six smaller striæ beginning at the lower and inner border of the lens and reaching near the center of the lens. Considerable haziness connected the striæ with each other and adjacent clear lens. Rough drawings of these appearances were made on the record, in connection with the written description.

Subsequent History.—About twice a year these eyes were restudied and descriptions and drawings made of the lens appearances. These show a general diminution of the striæ and associated opacity, so that on March 4, 1907, there was no trace of the long stria in the left lens, and only the extreme lower end of one of the shorter ones could be seen by turning the eye downward and inward. In the right lens one long stria had entirely disappeared, and another all but a trace; of the thirteen smaller striæ only the lower extremities of three remained, ten having entirely disappeared. On same date V. O. D. with glasses was 20/40 plus one and Jaeger No. 1; V. O. S. with glasses was 20/30 and Jaeger 1.

Though this patient was kept under conditions favoring the nutrition of the lens, there was no expectation of securing more than a retardation of the growth of the lens opacity. Hence the evidence that the striæ actually had changed into clear lens was a surprise. Especially startling was the disappearance of the large stria in the left lens during the first year. The other changes were less rapid.

Case 3.—Mrs. L. N., aged 65, on Oct. 20, 1903, sought relief from failing vision. She was a widow, slender, of nervous temperament and long a sufferer from chronic intestinal disorders.

Examination.—Vision of each eye was 20/100; the right increased to 20/70 plus D. 1.00 S.; the left to 20/30 by plus D. 1.50 S. She could read Jaeger I. right with plus D. 4.00 S.; left with plus D. 4.50 S. The right lens showed six long striæ reaching from the lower and outer border much beyond the center of the pupil. Numerous other short striæ filled much of the space between the longer striæ, and shading all was a diffuse haziness. The left lens exhibited four striæ extending from the outer and lower border to near the center of the lens, adjacent to which were numerous minute dots and diffuse opacity.

Subsequent History.—She was restudied two or three times yearly, and the conditions of improved lens nutrition were adjusted with care. On Jan. 4, 1907, at the end of a little more than three years, her condition was: Vision right eye, 20/200; with glass, 20/100. Vision left eye, 20/100, increased to 20/20 and Jaeger I. with glasses. In the right lens two of the six striæ had vanished, but the other four had increased, as also the irregular dots and diffuse opacity. In the left lens the four striæ had disappeared, except the lower third of one stria, which was only to be seen with difficulty; the diffuse opacity and dots had vanished, leaving practically a clear lens.

Remarks.—Thus the net results of three years was an increase in the opacity in the right lens, but practical clearing of the left.

CASE 4.—On July 24, 1906, Mrs. M. A. C., aged 68, sought relief from failing sight. She was a widow, stout and subject to rheumatism and intestinal infections. About three months before consulting me she had noted difficulty in seeing, and a couple of days previous a curving of straight lines with the right eye.

Examination.—Vision of right eye was 20/200, increased to 20/70 by plus D. 1.00 C., axis ninety degrees and plus D. 0.75 S. Vision of left eye was 20/50, increased to 20/40 with plus D. 0.75 C., axis sixty degrees and minus half a diopter sphere. Plus three and one-half diopter sphere added to the cylinders in the right eye gave vision Jaeger 6; in left Jaeger 1. A recent chorioiditis was noted in the right fundus. The right lens exhibited seven small striæ reaching from the lens border below to near the center, and three from above. In the left lens were two small striæ from the lower border of the lens to near the center. About the striæ in each lens were a few dots and a considerable diffuse opacity. A drawing of these was added to the word description.

Dec. 11, 1906: The vision of the right eye was 20/40 and left 20/30 without glasses. The right fundus lesion was less troublesome. The striæ in the right lens were diminished more than two-thirds; in the left more than three-fourths.

Net result of about four months was: Striæ in right lens diminished two-thirds; in left, three-fourths.

CASE 5.—On Oct. 17, 1906, Mrs. S. E. M., aged 57, Elmira, N. Y., sought relief from failing vision. She was a widow, large, fleshy, and long a sufferer from intestinal disorders.

Examination.—Vision of each eye was 20/70, increased to 20/50 by correcting glasses for a slight hyperopic astigmatism, with the rule. The right lens presented a long stria, crossing it vertically, with adjacent cloudiness. The left lens showed a stria crossing it with the top slightly inclined to the left; both striæ were shaded by considerable cloudiness.

Subsequent History.—On Nov. 29, 1906, a little more than a month after the first visit, vision of each eye was 20/30 minus two letters without glasses; 20/30 plus three, with correcting cylinders in right eye one and one-quarter, against the rule. left eye, three-quarter diopter with the rule. A comparison of the diagrams made on the two dates showed that the stria of the right lens had disappeared, and in the left greatly diminished.

CASE 6.—On Feb. 26, 1907, Mrs. S. M., a widow, aged 58, sought relief from distress on using her eyes.

Examination.—V. R. E. was 20/70 and was not materially increased by correcting the mixed astigmatism. V. L. E. was 20/50, increased to 20/40 by correcting the mixed astigmatism. With each eye she was able to read only Jaeger 14; with correction of refraction she could only read Jaeger 4. A careful study of the lenses, by oblique illumination and the ophthalmoscope showed in the right lens an opacity from below upward to the center of the lens, containing five large striæ and between them five smaller striæ. In the left lens were one large stria and four smaller ones.

Subsequent History.—Diagrams and descriptions were made of these, and on March 14 new observations showed that the following changes had taken place:

Right lens had lost four large striæ and three small ones, the remaining ones being far less pronounced. The left lens showed that two of the smaller striæ had vanished. Vision of R. E. had changed from 20/70 to 20/30; vision of left eye from 20/50 to 20/30 plus four letters; right eye Jaeger 2, and left eye Jaeger 1 with corrected refraction.

Case 7.—On April 23, 1877, H. R., Jackson, Mich., aged 45, was referred to me by the late Dr. J. A. Brown, for blindness. He was large and fleshy, had always been a voracious eater, and took little exercise. About a month before coming to me his physician had detected diabetes, and shortly thereafter the patient's sight failed rapidly, until he was only able to distinguish light from darkness. There was no red reflex, only a bluish gray lens to be seen by either oblique illumination or the ophthalmoscope. His physician said that the lenses were markedly striated when first observed.

After three months' treatment a second examination showed a perfectly clear lens in each eye, with normal fundus. His physician afterward told me that he faithfully followed directions and retained perfect sight until his death a few years later from pneumonia.

Thus in six cases of striated incipient cataract five lenses became quite transparent, one lens lost seven striæ, one lens lost two striæ, one lens retained a trace of a stria, in two lenses the striæ had diminished two-thirds, one lens became slightly opaque, and one more opaque. In the diabetic case both lenses became transparent and remained so till the patient's death.

In all cases the lens opacity was in its earlier stage, and so more was to be hoped from a radical change of its nutritive conditions. The patients were tractable and both able and willing to adjust themselves to prescribed conditions.

As these observations were out of the ordinary, on Dec. 19, 1906, a letter of inquiry was sent to a number of ophthalmic surgeons asking if they had seen "the opacity of incipient cataract regain transparency," attention being directed to the presence of striæ in the opacity. To this were received fifty-five negative answers; fifty-seven negative with comments, and thirty-four affirmative replies.

The replies are given in three groups:

First. Those reporting cases of opacity with opaque striæ in lenses that regained transparency, in whole or part.

Second. Those reporting cases of opacity of the lens in which the lens regained transparency—striæ not being mentioned.

Third. Those reporting cases of partial restoration of lens transparency.

It is regretted that lack of space forbids giving the verbatim answer of each correspondent, as such answers form a suggestive photograph of ophthalmologic thought on this question:

CASES OF INCIPIENT CATARACT WITH STRIÆ THAT RETAINED TRANSPARENCY.

Charles A. Oliver, Philadelphia, three cases.

George F. Suker, Chicago, two cases.

J. Elliot Colburn, Chicago, seven cases.

H. V. Würdemann, Milwaukee, Wis., three cases (two entirely, one partially).

As samples of the group, the following are given in the writers' own language:

J. W. Wright, Columbus, Ohio, says: "I have seen one case of incipient cataract regain transparency. In 1886 I examined the right eye of Mr. W., aged 74, for defective vision, and found a well-marked median cataract (incipient) with striæ also well marked, branching out in different directions. In about two years I again saw the patient when the lens had again regained transparency, and there was not the very least indication with a minute ophthalmoscopic examination that the lens had in any manner ever been affected. No treatment had been used."

G. Oram Ring, Philadelphia, says: "As regards the disappearance of the striæ of incipient cataract, I have only seen one case in which I could positively demonstrate an absolute disappearance of all the opacity. This case was seen about ten years ago and occurred in a lady about 40 years of age, who had a pronounced neuroretinitis, the summit of each disc being swollen to about 6. D. The vision sank from practically normal to the mere ability to count fingers at a few inches from the eyes. . . . Dr. W. F. Norris . . . saw the case in consultation with me. In expressing his opinion regarding the prognosis, Dr. Norris referred to several incipient striæ in the left lens and gave a questionable prognosis. Under specific medication—unguentum hydrargyri—followed by a long course of potassium iodid—the vision rose to 20/20 in O. D., and 20/25 in O. S. The case has remained under my care at certain intervals since that time. The vision has remained practically normal and the lens entirely transparent."

W. H. WILMER, Washington, D. C., says that he has seen one lens opacity give way to transparency. "Patient 51 years; good health; seen Nov. 3, 1904; had noticed dimness of vision in left eye three or four weeks previous to visit. Right eye vision with corrected refraction 20/20; left eye vision with corrected refraction 20/30. Lenticular opacities reached nearly to center of pupils from the lower and inner segment of each lens. Fundi and media normal. No treatment other than correction of refraction. May 31, 1905, vision normal in each eye; striæ in right lens unchanged; that in left can not be seen."

The following have been taken from medical journals:

AUGIERAS: *Ophth. Review*, Vol xxiv, p. 50, abs. from *L'Opth. Provincial*, one case.

ADOLPH ALT: Amer. Jour. Opth., Vol. xxiii, p. 297, one case.

J. ELLIOT COLBURN: THE JOURNAL A. M. A., June 4, 1887, three cases.

Total: Ten observers report twenty-three cases.

CASES OF LENS OPACITY IN INCIPIENT CATARACT, REGAINING TRANSPARENCY—STRIÆ NOT BEING NOTED.

CHARLES S. BULL, New York, from twenty-five to thirty cases.

FRANCES DICKINSON, Chicago, one case.

MARK STEVENSON, Akron, Ohio, about five cases.

S. O. RICHEY, Washington, D. C., two cases detailed and a number of others mentioned.

F. P. CAPRON, Providence, R. I., four cases.

FRANK C. TODD, Minneapolis, "more than one case."

JOHN CHASE, Denver, one case.

L. E. MAIRE, Detroit, one case.

H. BERT ELLIS, Los Angeles, Cal., three cases.

H. B. CHANDLER, Boston, "several cases."

A. E. PRINCE, Springfield, Ill., one case.

A. D. McCONACHIE, Baltimore, two cases.

C. M. CULVER, Albany, N. Y., three cases.

S. G. DALBANY, Louisville, Ky., "a few cases."

W. H. SNYDER, Toledo, Ohio, "many cases."

IRA J. DUNN, Erie, Pa., two cases.

HIRAM WOODS, Baltimore, "several cases."

W. J. PARK, Harrisburg, Pa., "have seen lenticular opacities disappear."

W. L. DAYTON, Lincoln, Neb., one case.

C. W. HAWLEY, Chicago, one case.

The following are taken from medical journals:

J. SEEGAN, two cases, and T. TANNAHILL, one case; both reported by E. Nettleship, Trans. Ophth. Soc. of United Kingdom, Vol. v.

R. **Kalish**: Med. Record, March 29 and Dec. 20, 1890, five cases.

Nicati: *Ophth. Rev.*, Vol. xviii, from Berlin *klin. Wochschr.*, Oct. 31, 1898, one case.

L. **de Wecker**: *Amer. Jour. Ophth.*, Vol. xxii, p. 204, one case.

Adolph Alt: *Amer. Jour. Ophth.*, Vol. xxiii, p. 296, one case.

Tatham Thompson: *Royal Lond. Hosp. Reports*, December, 1890, one case.

Total: Twenty-six observers report about eighty-four cases.

CASES OF PARTIAL RESTORATION OF LENS TRANSPARENCY IN INCIPIENT CATARACT.

Lewis S. Dixon, Boston, five cases.
C. H. **Beard**, Chicago, two or three cases.
A. J. **Irwin**, Los Angeles, Cal., one case.
P. **Jordan**, San José, Cal., one case.
L. L. **Alleman**, Brooklyn, five cases.
C. F. **Clark**, Columbus, Ohio, one case.
E. E. **Holt**, Portland, Maine, "a few cases."
W. E. **Briggs**, Sacramento, Cal., two cases.
S. C. **Ayres**, Cincinnati, two cases.
David Webster, New York, two cases.
B. F. **Fryer**, Kansas City, Mo., one case.
Dr. Ryerson, Toronto, Canada, one case.
H. **Harland**, Baltimore, "have seen cases fluctuate in both lens opacity and vision."
T. C. **Hood**, Indianapolis, four cases
Total: Fourteen observers report thirty-three cases.

SUMMARY OF OBSERVATIONS.

Ten observers report twenty-three cases in which they have seen striæ of incipient cataract disappear from one or both lenses, taking with them the diffuse opacity.

Twenty-six observers report about eighty-four cases in which they have seen the diffuse opacity of the lens in incipient cataract regain transparency—no mention being made of striæ.

Fourteen observers report thirty-three cases of incipient cataract regaining partial transparency.

Thus, including my cases, fifty-one observers report about one hundred and forty-seven cases, in which the opacity of incipient cataract has regained transparency in whole or in part.

After eliminating all indefiniteness from some of the reports enough remains to show that "opaque striæ with or without adjacent lens opacity have been seen to fade into clear lens substance."

All ophthalmologists grant that the phenomenon is rare; all agree that it is most frequent at the earliest stage of development.

In most cases the transformation of lens opacity into clear substance was quite "unexpected;" like Topsy in Uncle Tom's Cabin, "it just grow'd."

The demonstracted fact of regained transparency of the lens institutes the inquiry: How was the thing done? It also suggests the obligation of making a closer study of the conditions under which cataract develops.

103 Cass Street.

CONCERNING LOSS OF VITREOUS HUMOR IN THE OPERATION FOR EXTRACTION OF CATARACT:

ITS IMMEDIATE AND REMOTE EFFECT.*

J. MORRISON RAY, M.D.
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There seems to be great diversity of opinion among operators as to the exact consequences of loss of vitreous humor occurring as a complication in the operation for extraction of cataract. A general idea exists that it is an incident that they would rather not see occur, but that it has but little effect on the result of the operation. It has appeared to me that experience should give us more definite knowledge on this subject, and that we should know with exactness how much it militates against the final result.

Being a more complicated structure than the aqueous, loss of vitreous makes more demands on the reparative powers of the eye than does loss of the aqueous fluid. When once it has escaped, the replaced humor never takes on the histologic make-up of the normal structure. A new fluid secreted from the same source as the aqueous and with practically the same chemical make-up may fill out the space occupied by the lost vitreous, but the fibrillary network of the vitreous is never regenerated when lost.

Haemers found that an attempt was made to form a new structure which seemed to arise from the supporting tissues of the retina. If this be true, it is easy to see why detachments of the retina are so common as one of the later sequelæ to loss of vitreous.

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There existed among the older writers a wholesome fear of loss of the vitreous humor, and as a result of this accident operations for extraction of cataract were decried.

Mackenzie stated that the operation for extraction exposes the eye to loss of a large quantity of the vitreous humor and consequently to great danger of destruction of the organ.

Since the time of Mackenzie the introduction of the antiseptic treatment of wounds, and from this the evolution of modern aseptic technic has materially changed the prognosis. We find the Pagenstechers, the early champions of the operations for removal of the lens in its capsule, affirming that loss of vitreous has no concern so long as strict asepsis prevents a primary infection, and that cases in which the vitreous contains floating particles sooner or later clear, the larger the amount of vitreous lost the more rapid their disappearance.

Of material importance in considering the dangers from this complication is the stage of the opertaion at which the loss takes place. It may occur immediately after the completion of the corneal section, it may take place simultaneously with the escape of the lens or after the lens has been extruded. If it occurs immediately after the completion of the corneal incision it is evidence of the presence of degenerative changes in the eye resulting in the vitreous becoming fluid or the zonule being weak. If it occur during delivery of the lens or afterward, it results either from the character of the operation, the unruliness of the patient or the lack of proper technical skill on the part of the operator, the amount lost varying under these circumstances.

Beer has asserted that at least one-third of the vitreous must be lost before it will affect the result unfavorably. When it escapes before the lens is expelled the greatest danger is that the lens will drop backward into the remaining fluid and efforts at its removal cause a greater escape, and thus the possibility of failure to extract the lens; yet Arlt affirms that, the vitreous being fluid, a better prognosis can be expected than when it is of normal consistency, because in the latter condition it is more apt to remain between the lips of the wound and thus prevent proper approximation.

The character of the operation to a very large extent materially influences the occurrence of vitreous loss as a complication. If the corneal section is too small the pressure necessary for extrusion of the lens may cause escape of vitreous. If the section is too far back it removes the support of the strip of sclera supporting the suspensory ligament and thus favors rupture.

If the lens is removed in its capsule the danger is far greater than from any other method of extraction.

Pagenstecher, in his operation, lost vitreous in from 50 to 60 per cent. of the cases; Oxley lost it in 30 per cent. of cases, and Drake-Brockman in 28.67 per cent. Major H. Smith lost vitreous in 8.2 per cent. in a total of 1,651 cases, and more recently only 6.8 per cent. in 2,616 operations in one year.

In my experience, one of the most frequent causes for loss of vitreous is an improperly fitting speculum. If the upper arm of the speculum does not stand well out from the eye the slightest amount of orbicular spasm will force it against the sclera and rupture of the hyaloid with escape of the vitreous will ensue. This generally takes place while removing cortical material or making the toilet of the wound. For this reason I am in favor of removing the speculum as soon as the lens escapes and resorting to the use of the lid elevator for subsequent manipulations.

In a collection of several thousand cases, including those reported by Marshall, Herbert, Collins and others, I found the loss of vitreous in cases in which the capsule was divided, or the anterior layer removed by forceps, was 4.5 per cent. Being of the opinion, from personal observation and experience, that loss of vitreous added largely to our percentage of failures, I asked a number of operators of recognized experience as to their personal observations, requesting answers to the following questions:

1. Does loss of vitreous at the time of the extraction increase the danger of primary infection?
2. Does it increase the danger of iridocyclitis during the stage of healing?
3. Does it tend to produce secondary degenerative changes in the eye after a few months or years?

Some of the replies are as follows:

In answer to the first question:

Dr. Knapp stated that he does not think that a small loss signifies that there is danger, but as the vitreous is a good pabulum for microbes, the danger of infection must be increased by the loss.

Dr. A. W. Calhoun does not think that loss, if slight, materially increases the danger. He has rarely seen infection which could be attributed to such an accident.

Dr. David Webster is not sure that it increases the primary danger.

Dr. D. W. Greene, Dayton, Ohio, is of the opinion that primary loss adds to the danger of infection because the vitreous is probably the best culture medium in the body.

Dr. D. B. St. John Roosa thinks that loss adds to the dangers of infection.

In answer to the second question:

Dr. Knapp thinks that it does.

Dr. Calhoun, in his experience does not think that it adds a danger in the healing stage.

Dr. Webster believes that it adds to the danger at this time.

Dr. Greene thinks that it does add to danger during healing, through prolapse and entanglement of the iris.

Dr. D. B. St. John Roosa thinks that it adds to danger from this cause.

In answer to the third question:

Dr. Knapp thinks that degenerative changes continue for months or even years in certain cases. Infection often flares up and becomes alternately better and worse, finally terminating in softening of the globe.

Dr. Calhoun does not think that slight loss has much effect on the future of the eye, but profuse loss is dangerous at all times.

Dr. Webster thinks that beyond doubt it tends to degenerative changes, especially detachment of the retina.

Dr. Greene thinks that the later dangers are from detachment of the retina and hemorrhages, especially in cases of advanced arteriosclerosis.

Dr. D. B. St. John Roosa thinks that it produces later degenerative changes. He says: "I gave up trying to remove the lens with its capsule on account of loss of vitreous, which I came to regard as a serious accident."

The amount of vitreous lost at the time of the operation is a difficult thing to estimate properly. Herbert says that both the frequency and quantity of loss of vitreous are apt to be a little underestimated, especially in operations in which the capsule is removed.

The normal amount present is estimated at from six to eight grams by weight. When the hyaloid is once impaired and the vitreous begins to escape any muscular contraction or movement of the eye increases the amount. Even after the lips of the wound have been cleaned and the eye bandaged we have no assurance but what more will escape or protrude into the wound.

In regard to the danger in primary loss, most operators join in the statement that the vitreous is a perfect culture medium for organisms. Fuchs remarks that it is a natural cultivation gelatin in which microorganisms thrive most luxuriantly, yet experience shows that the primary loss from infection so much feared by Mackenzie is not so great as would be expected, a most forcible illustration of the value of asepsis in this operatoin. Major Smith, in 2,616 operations, lost vitreous in 160 cases. Nine eyes were destroyed by primary infection, among which were included three in which vitreous escaped, showing an increased danger of primary infection in these cases. The relative danger being about one to four hundred in uncomplicated cases and one to fifty in those in which vitreous was expelled.

In a personal experience of two hundred extractions three eyes were lost by primary infection. In one case a large quantity of vitreous was lost and the conjunctiva was cicatricial from an old trachoma. In another the vitreous prolapsed into the wound and by preventing proper approximation opened up an avenue for infection.

My observation of the later results shows in every case examined in which vitreous was lost changes that seriously interfered with the maintenance of useful sight. Without exception, I find the vitreous to contain floating particles or opaque shreds attached at one end and moving about with every motion of the eye when viewed with the ophthalmoscope at the time of the discharge of the patient. It has been impossible to follow all the patients for a long time, but in those who have been under observation for years the vitreous contains masses or shreds of opaque material, and repeated examinations show that these are not absorbed. So long as such a condition exists the danger from degenerative changes exciting an infection or retinal detachment is present. A few cases recently under my observation will illustrate the changes that are more apt to occur.

Case 1.—A man, aged 70, lost an eye following an extraction in another city. I did a preliminary iridectomy, hoping to add to the chance of recovery for the second eye. At the extraction four weeks later he behaved badly and squeezed the eye, losing about one-third of the vitreous, the eye partially collapsed. In order to get the wound to approximate properly, I injected a small quantity of normal saline. The wound healed and beyond a deep ciliary injection that persisted the eye looked well. Photophobia lasted for four weeks, at the end of which time the ophthalmoscope showed a very cloudy

vitreous with a faint fundus reflex. At the end of six weeks vision was counting fingers, but the ciliary injection persisted, the iris began to become discolored and an exudate slowly formed in the large distorted pupil. At the end of three months the eye began to shrink and vision was lost.

CASE 2.—In a patient now under observation the eye recovered from the operation with as little reaction as occurs in uncomplicated cases and vision of 20/100 was obtained, yet the ophthalmoscope showed a number of long shreds floating about. Six months afterward, the retina became detached and an iridocyclitis caused softening and degeneration of the eye.

Another complication that has come under my observation was the leaving of a quantity of soft lens material in the capsule as a result of loss of vitreous. The eye healed slowly and six weeks later, in attempting to divide the secondary obstruction in the pupil, a retinal detachment was produced.

It would seem that a careful review of the subject leads to the following conclusions:

1. Loss of vitreous at the time of an extraction adds to the danger of primary infection, this danger being irrespective of the quantity of vitreous lost, but depending largely on the care used in the preparation of the field of operation.

2. The danger of iridocyclitis during the stage of healing is materially increased by loss of vitreous. The increased activity in the blood vessels and lymphatics during the repair of the traumatism necessary to the operation for cataract being overtaxed excites changes in the iris and ciliary body that end in a hyalitis, with closing of the pupillary space and anterior phthisis.

3. When vitreous is once lost the material taking its place is probablv aqueous, the framework is never reformed and the vitreous becomes fluid throughout. Floating particles increase in amount as time goes by, fibrillary bands are thrown out from the retina to take the place of the reticulum of the vitreous. These bands contract, causing minus tension and retinal detachments, followed by the characteristic square atrophied eye due to the action of the recti muscles on the softened globe.

YEAST CELLS AS A PROBABLE CAUSE OF ULCERATIVE KERATITIS.

PRELIMINARY REPORT.*

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AND
SEVERANCE BURRAGE, S.B.
LAFAYETTE, IND.

It has long been admitted that flat yeast cells may be recognized as the cause of disease elsewhere in the living body. In 1900 Stoewar and Lundsgaard reported finding yeast cells in corneal abscesses. The following case, with its bacteriologic findings, is submitted in the hope that others may be stimulated to make similar observations.

Patient.—On Oct. 8, 1906, Mr. J. R. S. was referred to Dr. Keiper by Dr. C. B. Kern, because of ulceration of the right cornea. He was an employé of a company which makes box board out of straw.

Examination.—Examination showed a spot of ulceration on the right cornea in the upper outer quadrant, of about 2 mm. diameter and circular in outline. The spot was white and raised slightly above the corneal surface. Its duration was one week. The iris was inflamed, the cornea hazy and the vision reduced to 20/c.

Bacteriologic Examination.—The ulceration was scraped with a sterile platinum loop, and the exudate transferred carefully and immediately to a culture tube of Loeffler's blood serum and incubated. At the end of two days, a sufficient growth being manifest, it was examined by Dr. A. E. Allder, the associate of Dr. Keiper, and by Dr. Keiper himself. Several slides were prepared, methylene blue being the stain used. These all showed some rather large cells, resembling yeast cells, together with what appeared to be micrococci and diplococci. The culture was also examined in the hanging drop.

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Treatment.—This consisted in scraping out the whitish mass which revealed a deep ulcer of the cornea. In the depths of this calomel was applied daily until healing took place. At home the patient instilled a 1 per cent. solution of atropin every three hours and every hour bathed the eye in water as hot as the back of the hand would stand, using the eyeglass. In ten days the ulcer had healed, leaving a scar.

The culture was submitted to Professor Severance Burrage, of Purdue University, who, with his advanced class in bacteriology, since has been diligent in trying to determine and to identify the organisms present, and he submits the following report:

PRELIMINARY NOTES ON MICRO-ORGANISMS FROM ABSCESS IN CORNEA.

A culture made in blood serum directly from the abscess in the cornea gave evidence of the presence of at least three different species of organisms, one giving a pinkish, another of yellowish, and a third of a whitish transparent growth. A microscopic examination of a stained preparation from this culture showed also at least three kinds of organisms. One was a micrococcus, another a diplococcus, and a third round cells, sufficiently large to cause one to suspect them to be yeast cells. Subsequent investigation proved this to be the case.

Description of Forms.—(1) The yellowish growth, when separated turned out to be a sarcina, in all probability *Sarcina lutea,* showing many of the characteristics of that organism. (2) The pink form was a small bacillus, non-motile, non-liquifying, and producing the pink color only after eight or ten days. This bacillus has rounded ends and measures about 1.5 microns in length and .65 microns in width. No spore formation was observed. I have been unable to identify this organism, up to this time. (3) A diplococcus producing a white growth on culture was also separated. The coccus varied from 1 to 1.5 microns in diameter, was distinctly aërobic and did not liquify gelatin. It produced a white growth on potato. (4) The yeast gave the greatest difficulty in separating into pure culture. The cells varied greatly in size, so much so in almost every case as to make one doubt the purity of the cultures. The measurements showed variations from 2.5 to 6 microns in the normal shapes, and many of the elongated forms measured as much as 15 microns in length. From its microscopic as well as other characteristics, it is without doubt some form of blastomycetes.

Inoculation Experiments.—A number of inoculations on the eyes of guinea-pigs were carried out, and in every case in which a culture containing the blastomycetes was used, whether in

mixed or pure cultures, there was evidence of ulceration in the cornea of the eye inoculated. The evidence of such ulceration was determined first by the use of the fluorescin test, and second by the formation of cicatricial tissue evident to the naked eye. Thus far none of the blastomycetes has been separated from any of the inoculated eyes, but the experiments are still in progress, with the prospect of interesting results.

It is hoped that at the annual session of the American Medical Association, in June, we shall be able to submit the final results, together with photomicrographs of the organism, both separate and in the corneal tissue.

LIGATION OF THE COMMON CARTIOD ARTERY FOR MALIGNANT RECURRENT HEMORRHAGE OF THE VITREOUS.*

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BOSTON.

The object of this communication is to bring before this Section the subject of ligation of the carotid for the relief of a disease other than the vascular tumors of the orbit and lid in which this procedure is commonly employed. I refer to the rather infrequent cases of malignant, recurring vitreous hemorrhage.

The following example came under my observation a little over a year ago:

Patient.—B. K., 51, a healthy married woman of German birth.

History.—On the morning of Jan. 18, 1906, the patient noticed that the vision of her left eye was somewhat blurred. On the following day she applied for treatment at the Carney Hospital. Her family and previous history were negative. There was no evidence of hemophilia or of syphilis. There had never, to her knowledge, been any disease in her family and, as far as she knew, her eyes had always been normal. She had given birth to seven healthy children and her menses, always normal in character, had ceased four years previously.

Examination.—For the sake of brevity I will say here that several physical examinations made by members of the medical staff, at this time and during the succeeding year, were all absolutely negative. The heart and kidneys appeared entirely normal and there was no evidence of vascular disease. The blood pressure (Riva-Rocci) equalled 145 mm. The blood contained 5,568,000 red cells, 9,600 white, and 85 per cent. of hemoglobin. The patient was a stolid, well nourished woman with a good appetite and digestion.

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Ocular Examination.—The left eye was white, cornea, iris and lens normal, the pupil slightly dilated. The vitreous contained numerous small and large floating opacities. Situated about in the optic axis and best seen with a plus 12 glass was a peculiar membranous looking structure roughly square in outline, and suggesting an inverted pyramid in shape (base forward) rather than a flat septum. In color it was white, with irregular areas of black pigment along its borders, and on its surface were large splashes of fresh blood. Along the lower temporal border was a small hemorrhage extending into the vitreous. The retina and nerve head could not be seen. Vision: Counts fingers at one foot. Examination of the right eye showed a similar but somewhat smaller structure, situated in the same relative position and connected with the disc by a fine strand of grayish tissue. No vascularization could be made out. The vitreous was clear, and except for this structure nothing abnormal could be seen in any part of the eye. V. O. D. = 6/12 —, not improved by glasses. Increasing doses of mercury and iodid were prescribed, but seemed to have no lasting effect on the process. There was an occasional slight improvement and then would come a sudden diminution in vision caused by fresh hemorrhage on the membrane and increased clouding in the vitreous. By June the vision was reduced to the perception and localization of light, and the red reflex had entirely disappeared. On October 12 the patient again came to the clinic saying that two days previously the sight of the right eye had suddenly failed. Examination showed vitreous hemorrhage and large splashes of blood on the membrane. Vision = 3/60. The retina could barely be distinguished. Barring a greenish tinge to the iris the state of the right eye had not changed. She was taken into the hospital for observation and treatment. The course of the disease did not differ from that in the other eye. Under large doses of iodid and mercury the vision occasionally showed slight improvement only to fall off again from a fresh hemorrhage, which in each instance appeared to come from the membranous structure. Mercury and iodid gave place to lactate of calcium and large doses of gelatin,[1] and later to other drugs, over a period of three months. There was a steady loss of vision down to counting fingers at one foot, and it became increasingly evident that complete blindness would ensue were not energetic measures taken. Meanwhile, there was no sign of returning vision in the left eye.

Operation.—Remembering that in two somewhat similar cases, one reported by Mayweg[2] and one by Axenfeld,[3] ligation of the common carotid had apparently checked the disease, I explained to the patient the dangers of such an operation and the uncertainty of the result, and on the other hand the probability of blindness under medical treatment alone. Her good health and absence of all signs of vascular changes were in her favor. She chose to take the risk, and on December 10, the right common carotid was ligated by Dr. H. H. Germain under ether anesthesia. At this time the vision equalled counting fingers at one foot. The patient made an uncomplicated recovery from the operation save for a slight rise in temperature. She was kept in bed for two weeks.

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[1] We were unable at this time to estimate the coagulation power of the blood and treated her empirically on the assumption that it was retarded.

[2] Bericht d. Ophth. Gesellschaft zu Heidelberg, 1889, 92.

[3] Oberrhein, Aerzt., July 6, 1905 ;Münch. Med. Wochschr., 1905, lii.

Postoperative History.—December 11: V. O. D., counts fingers at five feet.

December 12: V. O. D., counts fingers at fifteen feet. With the ophthalmoscope the red reflex was perceptibly brighter.

December 14: V. O. D., counts fingers at twenty feet.

December 17: V. O. D. = 6/30. It was possible to distinguish the retina with both the indirect and the direct methods. The vitreous had cleared up markedly and the membrane was clearly visible. No fresh hemorrhage could be seen.

December 27: Patient discharged from hispital. Vision = 6/30+. There were no fresh hemorrhages and the vitreous was clearly slowly.

To our great disappointment, two days later there was a sudden diminution of sight and examination showed the membranous structure to be almost covered with fresh blood and the vitreous very cloudy. V. O. D., counts fingers at one foot. The attack came on spontaneously and did not follow exertion or excitement. Since that time the course of the disease has been about the same as before the operation and the vision on March 8 was limited to hand movements directly in front of the eye. The red reflex has almost entirely disappeared, but it is still possible to see the membrane faintly and to note that it is covered with blood.

PREVIOUS CASES.

Mayweg,[2] at the twentieth meeting of the Heidelberg Society, reported the following case:

CASE 1.—A 17-year-old peasant had lost the sight of his left eye from repeated vitreous hemorrhages, although under capable treatment. Three years after the left eye first became involved, a similar process affected the right, and recurred four times. At the fifth attack he came to Mayweg, who found extensive hemorrhage into the vitreous and vision reduced to 20/200. There was no evidence of organic disease. In spite of energetic treatment there were six further recurrences and finally, ligature of the carotid was resorted to. This checked the process and eighteen months later the vitreous was clear and the vision = 20/40.

CASE 2.—Axenfeld[3] saw a healthy girl, 24 years old, who had

lost the sight of her right eye from persistent vitreous hemorrhages followed by secondary glaucoma. Several years later the left eye became affected and the vision reduced to hand movements. Ligation of the common carotid controlled the disease and three months later there had been no further hemorrhage. The vitreous cleared up very slowly. I have been unable to obtain the later history of this case.

Before proceeding to consider the operative treatment involved there are one or two interesting features of the case reported above which deserve a few words. As to the nature of the membranous structures there is an element of uncertainty. On the one hand they may have been the organized remains of vitreous hemorrhage which took place at an earlier period in the patient's life, and very likely this would have been the assumption had the patient been seen only after the involvement of the second eye. It does not appear, however, that such was the true nature of the case for the following reasons: The structures resembled each other closely and were symmetrically placed. They were situated in the line of Cloquet's canal and, in the right, a fine strand of grayish tissue could be seen (before blood obscured the vitreous), running back from the structure to the disc. There was no vascularization and absolutely no sign of disease in the chorioid or retina (O.D.). It seems probable that we have in this case the remains of embryonic structures. Vitreous hemorrhages are occasionally observed in connection with a persistent hyaloid artery, as, for instance, in the case reported by Hickman.[4] Furthermore, it is well recognized that undeveloped organs form a locus minoris resistentiæ. The assertion of the patient at her first visit that the sight of the right eye had never been more acute favors this view.

It is worthy to note that in this case each hemorrhage appeared to take place from the substance of the membrane.

The rapid improvement in vision from 1/300 to 6/30+ in one week is striking evidence of the temporary efficiency of tying the carotid in these cases. On the other hand, the recurrence, ten days later, shows how quickly the circulation can be re-established from the collateral supply. That it was the operation which caused the improvement is hardly open to question.

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[4] Ophthal. Rev., 1902, 85.

For a time the patient was treated with lactate of calcium and gelatin on the theory that the coagulating power of the blood was diminished. As we were unable to determine then whether or not this was the case, and as there was no apparent improvement, this treatment was discontinued. Recently through the kindness of Dr. F. T. Lord, whom I here wish to thank, an estimation was made by Wright's method, and it was found that coagulation took place in 2 minutes and 50 seconds, the normal by this method being 1 minute 45 seconds to 2 minutes 10 seconds. Thinking that possibly the former preparation of calcium may not have been efficient, the patient has again been given this drug.

This method of determining the time of clotting is as yet in its infancy, but its great simplicity and availability give great promise. Although Wright and his assistants have indicated that retarded coagulation may be responsible for many and various lesions, there has as yet been little confirmatory evidence, still as in this case we have no other clue to the etiology, and as many other similar cases occur in which the causation is likewise obscure, the possibility of retarded coagulation as a cause is worthy of consideration in the future. Therefore, it would seem to be advisable to ascertain the clotting time in all such cases, and if it be slow the administration of calcium salts is indicated and may prove of marked benefit to the patient.

Whether we are justified, after medical treatment has failed, in proposing ligation of the carotid to these patients is the question which more nearly concerns us here. Our first consideration may well be the danger of the operation. We have a large mass of statistics on the subject of carotid ligation and they are somewhat complicated, owing to the fact that in pre-antiseptic days the danger of sepsis and of secondary hemorrhage had to be seriously considered, and added very materially to the mortality of the operation. Moreover, the disease for which the operation is performed has a marked influence on the mortality. It would seem fair to assume about the same rate of mortality after ligation for the cure of vitreous hemorrhage as that after the same operation for the relief of pulsating exophthalmos. Keller,[5] from the Zurich clinic, gives 4 per cent. in 31 cases.

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[5] Inaug. Diss. Zurich., see Michel's Jahrs., 1898, 606.

Slomann,[6] from 95 cases, some of the patients of which were operated on in the pre-antiseptic era, gives a mortality of 10 per cent. Werner[7] 10 per cent., Le Fort[8] 12 per cent., Murray[9] 10 per cent., De Schweinitz[10] 10 per cent.

For other diseases the mortality is much greater, as would be expected when we take into account the serious character of the lesions which call for this operation. Keller[5] gives 34-43 per cent., Le Fort[8] 43 per cent., Murray[9] 25 per cent. The total results of carotid ligation as quoted by Barnard and Rugby[11] are as follows: Tillman 31 per cent., Zimmermann 31 per cent., Pilz 18 per cent., and Friedlander 13 per cent.

As regards the dangers and complications of the operation, Erichsen, quoted by Barnard and Rugby,[11] says that cerebral symptoms occur early or late in 25 per cent. of the cases. The dangers of sepsis and hemorrhage may now be disregarded.

Blindness, from obstruction of the arteria centralis retinæ, has been noted by Elschnig,[12] Siegrist,[13] Gifford[14] and Uhthoff,[15] and has apparently in the majority of instances been caused by lodgment in this vessel of a fragment detached from the thrombus in the carotid. In an event this is an uncommon accident, for in the ordinary case closure of the carotid causes but a temporary disturbance of the retinal circulation. Uhthoff[15] and Hansell[16] have observed the temporary obliteration of the retinal vessels at the moment of ligation.

Sattler,[17] Wagenmann[18] and Silex[19] have seen lesions of the cornea, which have been referred both to trauma and to trophic disturbance. Axenfeld[20] has reported homonymous hemianopsia following ligation, and

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[6] Doctordiss. Copenhagen, see Michel's Jahresbericht, 1898, 612.
[7] Inaug. Diss. Tübingen., seen Michel's Jahresbericht, 1898, 617.
[8] Rev. de Chir., 1890, May and June.
[9] Ann. of Surg., 1904, 421.
[10] Quoted in Modern Ophthalmology; Ball, 640.
[11] Ann. of Surg., 1904, 649.
[12] Arch. f. Ophth., 1893, xxxix, 151.
[13] Ber. d. Ophth. Gesell. z. Heidelberg, 1898, 10.
[14] Ophth. Rec., 1899, 595.
[15] Ber. d. Ophth. Gesell, 1898, 21, 22.
[16] THE JOURNAL A. M. A., 1905, 536.
[17] Quoted by Siegrist (13).
[18] Quoted by Siegrist (13).
[19] Ber. d. Ophth. Gesell., 1898, 23.
[20] Ber. d. Ophth. Gesell., 1898, 22.

Michel[21] has seen cataract following thrombosis of the carotid.

In the case of a patient operated on in Boston hemiplegia and death followed carotid ligation and the autopsy showed the absence of the circle of Willis. All these complications are, however, of rare occurrence and need not be considered here.

Having spoken of the dangers and mortality of the operation, we must now consider what changes the patient has of benefiting by it, and here we have but little information to guide us. In pulsating exophthalmos we may assume from the statistics 50 to 80 per cent. of cures from the operation, but in recurrent vitreous hemorrhage we have only the three cases above on which to base an estimate. Mayweg's was successful, Axenfeld's successful up to the end of three months (later progress unknown), and the case reported here was a failure. The two favorable ones occurred in youth, mine in middle age.[22] In all three it was done as a last resort. On the one hand stands an operation of considerable risk and of uncertain value; on the other is almost certain blindness. In making a decision, the age of the patient and the condition of the vascular system are of great importance. In my own case no lesions could be found, but her age made it possible that they were present. We estimated her risk at from 15 to 20 per cent. In all cases with healthy vessels and no complications, and where the patient has chosen to run the risk after an impartial statement of the facts has been given, I believe that the operation is justifiable. Naturally this refers only to those cases in which the vision of one eye has already been lost and in which medical treatment offers small hope of saving the second eye.

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[21] Quited by Siegrist (13).

[22] Pollack (Michel's Jahresbericht, 1900, 368), has reported a case in which the artery was tied in a patient 66 years of age, and the second one ligated five years later without accident.

THE DELIVERY OF THE LENS FOR THE EXTRACTION OF CATARACT; IRRIGATION OF THE ANTERIOR CHAMBER, AND THE FIRST TOILET OF THE WOUND.*

L. WEBSTER FOX, A.M., M.D.
PHILADELPHIA.

The second stage toward the successful completion in cataract operations depends, first, on the length and character of the corneal incision; second, on the laceration of the capsule or the removal of the lens within its capsule through the opening in the cornea. The importance of the amplitude of the incision is so well known to all ophthalmic surgeons that, in his symposium, Dr. Weeks has undertaken to embellish this part of our subject with the care and precision which characterize all his writings on ophthalmology. Dr. E. E. Landolt of Paris has recently written an historical review of all the work done on this subject in a monograph of 130 pages.[1] So, with Dr. Weeks on this side of the Atlantic and Dr. Landolt on the other, the ophthalmic world will be made thoroughly conversant with all that can be said or written on that delicate incision in the cornea, so important to the success of a cataract operation.

To carry out the mechanical and geometrical incision properly entails close study, for there is no operation in surgery so dependent on the cunning of the hand and its delicate training as this. Each cataract case is a law unto itself, and the operator who does not recognize immediately the necessity for a different kind of incision in patient A from that required in patient B has much to learn. No two eyes are alike; therefore, no two incisions can be mathematically the same in corneæ with varying geometrical areas.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

[1] La Surface de Section des Plaies Faites en vue de L'Extraction de la Cataracte et de L'Iridectomie, 1905.

With the proper incision we advance to the second stage of the operation. Shall it be with an iridectomy or without? My experience leads me to believe that if we were to operate alternately on a series of cases we would obtain far better ultimate results in at least 75 per cent. of the cases in which an iridectomy is performed, than in those in which the simple method is carried out. I have had my share of successful results by the simple method, but they have always been in selected cases.

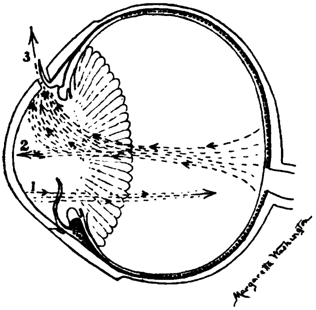

Fig. 1.—Currents of the eye, the results of pressure: 1. Showing primal pressure toward the optic nerve. 2. Currents returning, due to counter pressure. 3. Exit through corneal incision and floating iris.

IRIDECTOMY.

The iris may or may not present itself at the apex of the wound after the incision. It usually bulges forward, but may be replaced by gentle pressure with a Daviel spoon. It is then grasped with the proper iris forceps, drawn gently forward, and with one snip of the scissors is cut off close to its base. This gives the ideal keyhole iridectomy, and a space large enough for the escape of the lens without bruising the pillars of the iris, thus avoiding the complication of iritis, which is so apt to follow. In the simple operation, the hardened lens has to be forced through a space much smaller than its own diameter. This means an unusual stretching of the circular fibers of the iris; a partial paralysis is the result, which even eserin fails to hold in contraction, and is followed probably by incarceration in the lips of the wound. The currents of the fluids of the eye which flow from the wound are strongest at its apex and sweep the iris into this space like a floating flag, while the wound heals from its base toward the center. So long as there is the most minute opening, the currents of the eye flow rapidly or slowly according to the intraocular pressure, thus keeping the iris constantly in the gaping wound until closure takes place. In many examinations of the iris, I have found that its pupillary margin projects forward, and when this iris is bruised or stretched to the point of paralysis, it can be easily understood how the currents of the eye can sweep this floating tissue into the fissure of the incision. With this explanation it is readily understood why so few simple operations have the beautiful round pupil and the iris in its proper place. The successful cases of simple cataract operations are those in which the cornea is larger and the anterior chamber is deeper than usual and the iris appears to hang perpendicularly (from its base). With all such conditions confronting one, it is not difficult to understand why, in the hands of the larger number of operators, an iridectomy is preferable.

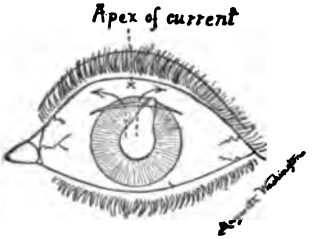

Fig. 2.—Incarceration of the iris due to paralysis of the circular fibers in simple operation.

HISTORY OF THE OPERATION BY EXTRACTION AND THE INSTRUMENTS DEVISED FOR OPENING THE CAPSULE.

To Daviel, a French surgeon, we are indebted for the operation for removing cataract by extraction as a routine practice. He performed this operation in 1747, although it was not a new discovery, for Rhazas, in 1529, says that "about the end of the first century Antyllus opened the cornea and drew the cataract out of the eye with a fine needle or hook," in which practice he was followed by Lathyrion.[2] If history is correct, this operation was forgotten or neglected until St. Yves

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[2] Guthrie: Lectures on Operative Surgery, London, 1823, p. 290.

(1707) performed the operation of extraction and described the operation in the following words:

> When the operation of removing the cataract, which has passed into the anterior chamber, is to be performed, the patient must be seated on a chair, with the eye fairly opposed to the light; the lids are to be kept open with the thumb and forefinger of the right hand, the cornea is opened with a fine cutting lancet, commencing a little below the level of the pupil and continuing it across to the opposite edge, so as to leave only half a line on each side of the lower half of the cornea undivided. Through this opening a fine curette is to be introduced; and, by passing it behind the crystalline, its extraction is to be accomplished.

In 1708, Petit performed an extraction by the same method. Freytag (1721) also resorted to extraction through the cornea with a "hooked needle." The work of St. Yves and Petit led Daviel to follow the same method and he evidently made some improvements in the instruments of his day for the successful delivery of the cataract, for he speaks of using a small spatula (flat needle) with which he drew out from behind the pupil the different portions of the lens. Plantner (1780) speaks of extracting the lens through the corneal wound either with forceps or a little hook. From Daviel's time to the present, many instruments have been devised for opening the capsule and delivering the lens, and the end is not yet. From various sources I have succeeded in gathering together almost every form of cystitome in use from Freytag, No. 1 (1721), down to the latest model of to-day. From the variety of these models, operators of 150 and more years ago were quite as ambitious to suit their own individual methods and to be remembered by these instruments as are the surgeons of to-day.

OPENING OF THE CAPSULE.

Many of the older operators removed the speculum after making the incision, and have the lids separated by the fingers of a trained assistant, or, raised by lid elevators so as to remove all pressure from the eyeball, and the same method is followed by some operators to-day. In my own practice I have rarely found this necessary. The speculum of Clark, from its shape and balance, seldom produces pressure on the globe heavy enough to press forward the vitreous; therefore, I dispense with an assistant.

Which cystitome is the best? I have tried nearly all the models used to-day, and each and every one has its advantage and disadvantage. The hooked needle and small sickle-shaped cystitomes of the older surgeons were introduced into the anterior chamber through the invision of the cornea with the concavity turned upward till the point is opposite the pupil. The point was turned inward and through the capsule, then drawn from side to side, and, freely dividing that membrane, it was carefully withdrawn with the convexity of the instrument downward.

While attending the clinics of Arlt in Vienna, I found

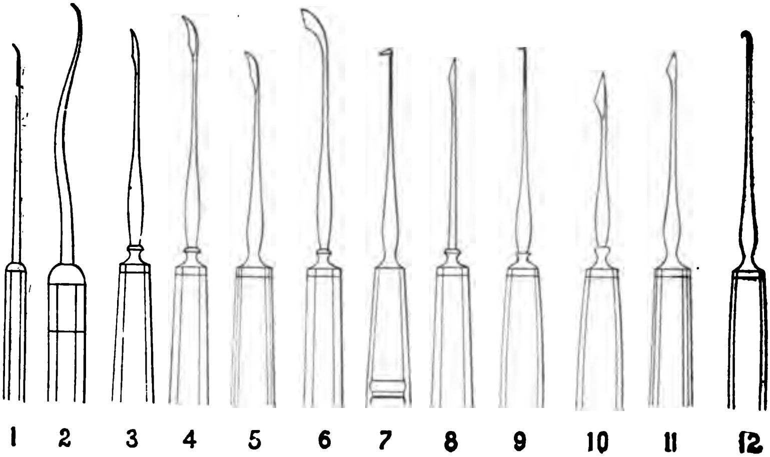

Fig. 3.—Cystitomes as used by: 1, Freytag; 2, Baron Wenzel; 3, Langenbeck; 4, Rosas; 5, Boyer; 6, Ritterich; 7, von Graefe; 8, Wardrop; 9, Arlt; 10, Desmarres; 11, Cusco; 12, Becker.

he used a hook (Figs. 3, 9) with which he made a triangular flap in the capsule; Jaeger always very successfully used the right-angled cystitome (Fig. 4, 15), while Mauthner preferred the flexible cystitome of von Graefe (Fig. 3, 7). The cystitome of Jaeger appealed to me as one of the safest, as well as the most mechanically perfect in shape and less liable to become engaged in the iris, so it is the one that I have used in many cases. The instrument is passed into the anterior chamber, gently pressed against the cornea on the nasal side until it reaches the pupillary margin of the iris below, slightly turned backward and hooked into the capsule—not too deeply—then drawn upward toward the top, lacerating the capsule in its upward movement. It is again passed downward through this same opening, passing across horizontally until the iris boundary is again reached, a second vertical tear is made to the top across to the first incision. In this way a rectangular opening of a large size is made in the anterior capsule. Meyer attempted this same operation with the double cystitome invented by himself (Fig. 4, 17). This instrument is introduced in the ordinary way into the anterior chamber; on arriving at the inferior

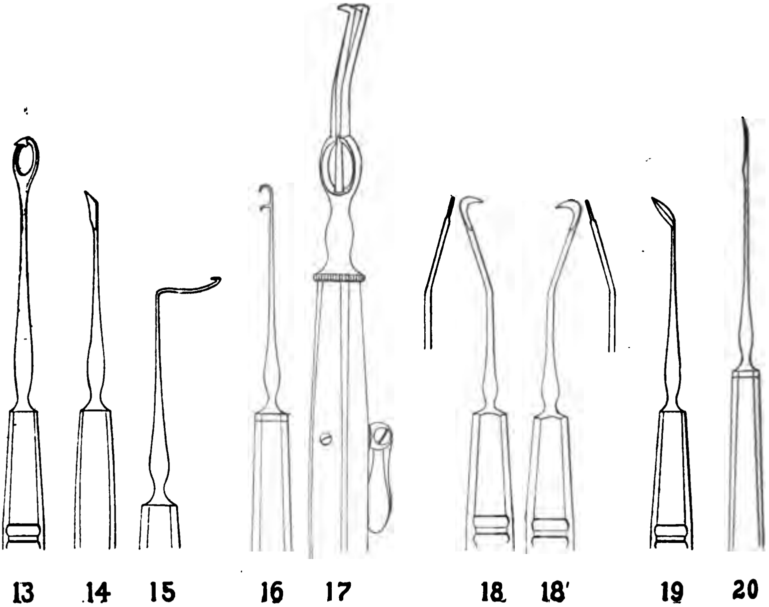

Fig. 4.—Cystitomes as used by: 13, Bettremieux; 14, Knapp; 15, Jaeger; 16, Weber; 17, Meyer; 18, Landolt, right and left; 19, Ziegler; 20, Galezowsky.

margin of the pupil, by pressing a lever, the cystitome becomes double; and, on drawing it back toward the corneal margin, a large central opening is made in the capsule. Before withdrawing it from the wound it is closed and this brings out the capsular flap. This instrument never became very popular, and now with many others is only an ophthalmic curiosity. While in Heidelberg I saw Becker use a cystitome (Fig. 3, 12) which bears his name and he used it most successfully. Weber (Fig. 4, 16) improved this instrument by devising a double hook, the fine teeth of which are placed one beneath the other. "He moves it in the capsule from one side of the pupil to the other and from the two angles of the capsular wound toward the incision in the cornea. If the capsular flap remains attached to the hook it is snipped off with the scissors." Geyet proposed to open the capsule near its superior borders by slight pressure. He tilts the margin of the lens into the corneal wound and then opens it with a small linear knife. Trousseau and some other dexterous surgeons pass the point of the knife through the capsule in making the corneal incision. This is not so difficult as would appear at first sight. It is done in the following way: Point the knife toward the tip of the nose, and, as soon as the instrument has entered the anterior chamber, pass the iris, dip the point of the blade into the capsule, then throw the handle backward and downward; this raises the point of the knife, lacerating the capsule and making the counter puncture in the cornea. Knapp (Fig. 4, 14) also adopted the peripheral incision with a cutting cystitome, and by his teaching both his instrument and method have been extensively followed. This cystitome is very similar to that used by Boyer (Fig. 3, 5), who lived during the eighteenth century. Landolt (Fig. 4,

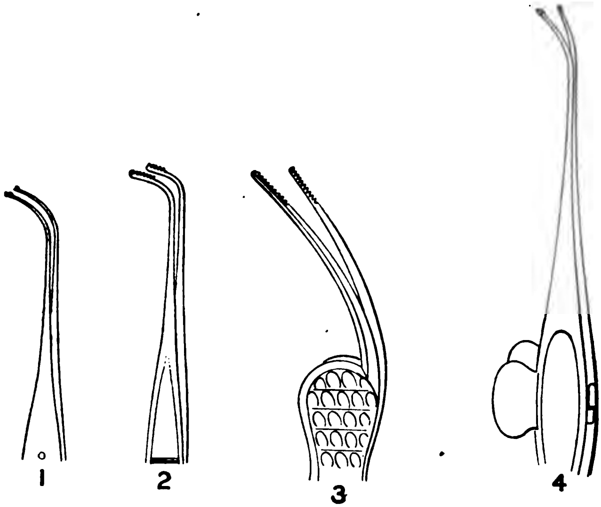

Fig. 5.—Capsular forceps as used by: 1, De Wecker, 2, Foster; 3, Collins; 4, Liebreich.

18) has devised a right- and left-hand cystitome adapted for each eye, but at convenient angles to be inserted in the anterior chamber. Ziegler (Fig. 4, 19) has devised a lance-shaped cystitome which I have found extremely useful in making a large cut in a thickened capsule. The flexible cystitome of to-day (Fig. 3, 7) with its small-cutting lance-shaped blade was used by each and every surgeon at Moorfields in London during my term of service there, and it is probably used by more ophthalmic surgeons than is any other form. De Wecker (Fig. 5, 1), Foster (Fig. 5, 2), Collins (Fig. 5, 3), Liebreich (Fig. 5, 4) have substituted capsular forceps specially devised for grasping and extracting as much of the anterior capsule as possible. This method of opening the capsule requires great delicacy of touch and immobility of the eye. It is not my province nor wish to speak about the merits and demerits of each and every one of the many cystitomes made; I have only mentioned a few which I have found the most mechanically perfect and best adapted to lacerating the capsule.

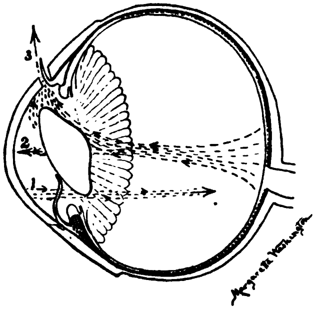

Fig. 6.—Demonstrating the forces which expel the crystalline lens: 1. Primal pressure with spatula on cornea. 2. Currents returning, tilting lens. 3. Exit of crystalline lens through corneal incision.

After the capsule has been opened by any one of the instruments described, cystitomes or forceps, the next stage is the delivery of the lens. Pressure on the lower half of the cornea and gentle pressure against the upper lip of the incision causes the eye currents to move backward in the lower half of the eye and forward in the upper half of the globe in direct ratio to this pressure and counter-pressure. The lens (Fig. 6) is thus made to tilt forward on its equatorial axis and by continued gentle pressure below it is forced forward and upward with the currents finding their way through the incision, and thus the cataract is gently expressed. If the pressure is too great, caused by the heavy hand of the operator, or a spasm of the muscles of the globe or eyelids, the lens is forcibly expelled and a gush of vitreous is sure to follow. The latter result was experienced during an operation for extraction, performed before the senior class in the amphitheater of the Medico-Chirurgical College. The eye had been thoroughly anesthetized and the patient was passive, yet, when the incision was made, an involuntary spasm of the orbicularis muscle took place forceful enough to close a Clark stop speculum. The force exerted was so great that the lens was thrown above my head and fell on the floor some distance from the patient. In another case the force exerted was not so great and the lens did not fly more than six inches from the eyeball. Some operators use the fixation forceps as a means of exerting counter-pressure, but any one thinking for a moment of the effect and counter-effect of this force on the fluids of the eye must at once realize the cause of many failures in expelling the lens. This is explained (Figs. 1 and 2), first, as to the effect of pressure on the lower third of the eye; second, the cause of a one-sided prolapse of the iris when the pressure is not properly exerted on the eyeball directly in the median line.

THE REMOVAL OF CORTICAL SUBSTANCE.

Is it deleterious to allow cortical substance to remain? I think it is to a certain extent. My observation has been that the posterior capsule always grows denser, and, in consequence, is more obstructive to vision when the tenacious lenticular masses are allowed to remain in the anterior chamber. I use massage first, and the Daniel curette second, then follow this by irrigation, if I have not cleared the anterior chamber sufficiently by the two methods mentioned. As soon as the cataract has been expressed the speculum is removed. Pressure is then brought to bear against the upper eyelid with the thumb of the left hand as a fixed point, and with the tip of the little finger of the right hand, the lower lid is gently pressed against the lower third of the cornea. Then, with an upward movement through the medium of the lids, all extraneous matter possible is forced out through the lips of the wound. This action usually cleanses the anterior chamber, leaving the pupil a velvet black and the iris in its proper position. Sometimes with this massage it is not always possible to clear the pupillary space nor the anterior chamber from all cortical substance; the curette is then called into use.

The curette has a limited field and removes only such particles that lie in the pupillary area, it being unsafe to pass the curette behind the iris and into the folds of the posterior capsule. Massage and the curette are only safe in the combined operation; the latter is not applicable in the simple operation. If I find that the pupillary space is black and the pillars of the iris stand out clear I let well enough alone and close the eye; but, if the anterior chamber presents a hazy appearance, I resort to irrigation with a physiologic salt solution—the mercuric salts or distilled water should *not* be used, as both have a deleterious effect on the endothelium of the anterior chamber. I have in my possession various irrigators—McKeown's, Lippincott's, Elliott's and the simple pipette of Terson. The most practical and safest is McKeown's, for with this instrument the fluid reaches every part of the interior of the capsule and forces out with the current all extraneous material and the cornea assumes its normal convexity.

I am firmly convinced, however, that the fewer instruments placed in the anterior chamber the better, but when necessity compels, the methods I have suggested are, I believe, the safest and best.

EXTRACTION OF THE CATARACT WITHIN THE CAPSULE.

From incomplete knowledge of the earliest operations, and from the models of instruments that have come down to us through the centuries, it is safe to say that whenever the cataract was displaced, first, by depression, and second, through the cornea, it was taken out of the line of vision within its capsule. I shall not deal with the couching method, but simply mention the extraction of the cataract through the cornea within its capsule. The first surgeons who succeeded by this method were Freytag (1721), Janin, Heckel and Richter, about the year 1773. A little later Mohrenheim, and especially Beer (1799), advised this method. It was again revised by Christiaen (1845), who strongly recommended it. Then followed Sperino, Gioppi, Feneglio, Gradenigo, Rosmini and Alexander Pagenstecher. The latter, from 1865 to 1875, performed 353 operations, and his work was given to the world in an article published by Dr. Hermann Pagenstecher, his brother, in 1877.

Delgado of Madrid attempted to extract the cataract in its capsule in the following manner:

> He begins by introducing into the anterior chamber, as in discission per corneam, an instrument combining the needle with a spatula; with this he detaches the lens and makes it mobile by gentle pressure on the periphery of the cataract. Having done so, he withdraws the instrument, waits until the aqueous has again filled the anterior chamber, and then extracts the lens in its capsule, using von Graefe's peripheral incision and the superior iridectomy.

From the days of Pagenstecher and Delago until the present day many operators have had cases in which, owing to a thickened capsule and atrophy of the suspensory ligament (zonule of Zinn), they have delivered the cataract within its capsule without difficulty. Encouraged by this, they have operated on patients in whom these conditions did not exist and have not met with the same brilliant results.

For several years past, whenever I have found a hardened cataract with a thickened capsule and atrophied suspensory ligament, I have dislocated the lens with a Jaeger's cystitome (Fig. 4, 15) and then extracted the lens within its capsule. My method is as follows: Passing the instrument into the anterior chamber and hooking the lens at its inferior margin I make a backward pass, at the same time pressing the upper lip of the incision very gently downward and backward; this tilts the upper part of the lens forward; the lens is then brought back into its normal position, and this is followed by rotation on its axis, done by hooking the cystitome in the capsule. Then, removing the cystitome and by counter pressure on the lower third of the cornea with a tortoise shell spatula, I express the cataract through the incision without loss of vitreous. During the last five years I have operated on at least fifty patients by this method, and I find it preferable to the method advised by those operators who express the lens within its capsule by pressure. In the last ten cases, in which I followed the method suggested by Pagenstecher, Smith, etc., I have found considerable excitation of the iris, more or less pronounced irritability in healing, the eyeball remaining red, and there is also much distortion of the iris. Among the Anglo-Saxon race I am certainly not in favor of the operation of extracting the lens within its capsule as a routine method. Even in those cases in which I have delivered the lens within its capsule and in which the suspensory ligament was atrophied and no secondary inflammation followed, the average visual acuity obtained was no better than in those cases in which the ordinary operation was performed.

I have stated that the openings of the capsule are many and varied, and so are the instruments to make these openings. Each cataract is surrounded by a pathologic capsule. This change may be invisible to the naked eye, or very much thickened and dense and easily detected by oblique illumination, and yet it is very difficult to recognize the different types. Diaphanoscopy does not help us, oblique illumination may in some cases, but it is not to be relied on. I have found that the age of the cataract and the senility of the individual are the best guides. A cataract of one year's growth has a capsule with a bluish cast; a cataract of two years' growth has a capsule with a pale color, moderately dense in appearance; a cataract of three years' growth and over, has a capsule of yellow cast, and is dense and inelastic. As the cataract matures the capsule thickens, while the zonule of Zinn, or suspensory ligament, grows thinner or degenerates. I have found this classification of cataracts on the whole fairly accurate.

DISLOCATION AND MALPOSITION OF THE LENS.

Occasionally a dislocation of the lens occurs when the corneal incision is made or when the incision is not long enough and too much pressure is exerted in the center instead of in the lower third of the cornea, forcing the lens backward instead of tilting it forward. Sometimes a prolapse of vitreous takes place after the incision of the iris or after the laceration of the capsule. This is an evidence of a rupture of the zonule of Zinn and a partial dislocation of the lens. The speculum should be removed at once, the patient allowed to rest quietly for a few minutes, the eyelids then separated by a trustworthy assistant and the lens immediately extracted by means of a scoop (Waldau "Schuft," Critchett's, Bowman's or Levis's). If there is much loss of vitreous and the eyeball becomes flaccid, the eyelids are separated and the eyeball, through the anterior chamber, is filled with a tepid physiologic salt solution.

ECTOPIA LENTIS.

In rare instances we meet with a congenital displacement of the crystalline lens upward or downward to the nasal or temporal side. When we meet with cataracts of this character it would be unwise or dangerous to make a corneal incision and attempt to extract the lens through the opening with a scoop; the vitreous is fluid and would certainly escape in large quantities, causing a total collapse of the eyeball and consequent loss of vision. In such cases it is safer to follow the couching method, for it is almost impossible to extract the cataract by the ordinary method and at the same time preserve the integrity of the eyeball.

LENS IN ANTERIOR CHAMBER.

The crystalline lens may find lodgement in the anterior chamber and cause an irritation to the iris and ciliary body. I have found that when the dislocated lens remains in the anterior chamber for more than a year it solidifies and becomes a calcareous mass without an increase or loss in its size. It then becomes a serious menace to the eye by causing iritis or iridocyclitis, but the greater danger lies in its provoking sympathetic ophthalmia. To remove this foreign body I make an incision through the horizontal plane of the cornea. The puncture is made near the outer side of the cornea directly into the anterior chamber, the point of the knife is passed along until the foreign body is approached, then the point of the blade is passed over it and beyond to the point of counter puncture, thus making a long incision through the center of the cornea. The speculum is then removed and the anterior chamber opened by pressing the partially closed eyelids with the thumbs of the right and left hand. If the calcified lens can not be forced out in this manner a small hook may be passed through the incision back of the lens while the pressure is maintained with the thumb of the right hand above and the lens then drawn out. By this method I have successfully removed the lens in five cases.

LOSS OF VITREOUS.

Is the loss of vitreous, in large and small quantities, detrimental to the success of the operation? The surgeon of to-day looks on the loss of vitreous with great seriousness and aims to prevent it at all hazards. Some of the older authorities did not take the loss of vitreous with much distrust, for Lawrence says:

> The escape of vitreous humor is not to be regarded in itself as a very serious circumstance. The space which it before occupied is filled by aqueous secretion. There is no doubt that one-fourth or one-third, and perhaps even one-half, of the vitreous humor may be lost in this way without interfering with the result of the operation. In many instances it seems rather to contribute to success; it lessens the bulk of the globe, and thus prevents the tension which occasionally succeeds the operation. Sometimes there is a spasmodic action of the muscles, propelling the vitreous humor against the cornea and preventing the apposition of the flap. I have in such cases introduced the curette through the pupil and let out some of the vitreous humor purposely.

In my opinion it should be our aim to deliver the lens without loss of vitreous. I have had a few cases in which at least one-fourth of the vitreous was lost, but instead of allowing the globe to remain in the flaccid condition, which this loss of vitreous would entail, I have immediately filled the eyeball with a tepid saline solution (physiologic salt solution) and have had good recovery ensue. When this has not been done and the condition has been left to Nature, subacute glaucoma has almost invariably followed. It is only fair to state, however, that in these cases the tension was slightly above normal before operating and that glaucoma, in an insidious form, may have already existed. For a trifling loss of vitreous no heed need be paid other than a careful snipping of this bead from the lips of the wound and a gentle backward stroking of the edges of the incision. If at the end of twenty-four hours there be again a protrusion of vitreous it should be cut off and the lips of the wound touched with a 1 per cent. solution (5 grains to the ounce) of silver nitrate. When the vitreous humor has its normal consistency prolapsus rarely follows the first cleansing of the wound immediately after the operation. It is impossible to prevent prolapsus in those cases in which the vitreous has degenerated and become fluid. Here it may be necessary even to go so far as to stitch the opening with two stitches of silk thread to prevent leakage, as I have done on several occasions. If we could foresee this condition—but I know of no physical sign by which we can discover the fluid vitreous—no surgeon would follow the ordinary method of operating in such cases. If we could be sure of our premises the only justifiable operation here would be the couching method.

To-day the ophthalmic world is slowly turning toward the Orient and watching with interest the work done by Surgeon Major Henry Smith, I. M. S., in delivering the lens within the capsule. In such a prolific field as India, with its three hundred millions of inhabitants, an ophthalmic surgeon has unlimited opportunities to put into practice any method to which he aspires. If one surgeon can perform 2,616 extractions in one year, with the following results, iritis 0.3 per cent., escape of vitreous 6.8 per cent., capsule bursting 8 per cent., capsule left behind 4.28 per cent, first class results 99.28 per cent., second class results 0.3 per cent, failures 0.34 per cent., it must make the ophthalmic surgeons of Europe and America hesitate to give their results drawn from the meager field around them. My experience leads me to agree with Surgeon Major H. Herbert, I. M. S., of Bombay, who says: "Extraction within the capsule is, with us, commonly reserved for over-ripe cataracts in which the capsule is not only opaque, but also too tough to be torn by the cystitome." He further says: "I have been surprised and disappointed to find the average visual acuteness obtained by this operation, tested by spherical lenses on discharge from the hospital about a fortnight after the operation, to be certainly no better, and, perhaps, rather inferior to that obtained by the ordinary operation." In commenting on the work done by these two operators of equal ability in the same field, with the same race, we have diametrically opposite opinions as to the value of the operation of removing the lens within its capsule.

Meyer of Paris, one of the most skillful ophthalmic surgeons of his day, in speaking of this operation twenty-five years ago, said:

> Extraction of the lens in its capsule does not appear to be admissible as a general method applicable to all cases, but should be restricted to those in which it seems probable that the strength of the suspensory ligament is defective—for example, when the cataract is over-ripe, when the iris is tremulous, and in strongly myopic eyes in which a general distension of the globe exists.

Macnamara says:

> This is by no means a new method of extraction of the lens, having been practiced with varying success since 1775 and strongly advocated by Pagenstecher and M. Sperino. Having performed this operation extensively since 1864, I am convinced that if it were possible in every case in which we operate to remove the lens in the capsule without damaging the other structures of the eye, we should have reached perfection in the extraction of the cataract.

Dr. D. W. Green,[3] Dayton, Ohio, in a recent article, his given his experience in operating in twenty-four cases by the so-called "Indian method." He says:

> Is it an operation that ought generally to be adopted, as Smith contends it should be, by the average operator and in the average class of cases? I think not, for the following reasons: It is more difficult to deliver the lens in this way than with the capsulotomy, even if one be experienced with the method. The operator who only does ten or twelve operations a year or fewer can not from this small number acquire enough skill to do justice to the method himself.

In referring to Dr. Green's statistics his results were not encouraging.

> The lens was delivered entire in 55 per cent.; vitreous was lost in 35 per cent.; glaucoma followed in 15 per cent.; iritis in 20 per cent.; and an average of 20/70 vision was secured with correcting glasses.

WHAT METHOD SHOULD WE ADOPT?

From the recorded experiences of many ophthalmic surgeons no doubt the conservative instructors in ophthalmology would select the combined operation as the method to be taught in our schools of ophthalmology for the younger ophthalmologists to follow. The combined operation, in the hands of the majority of operators, good, bad and indifferent, the world over, gives a larger number of perfectly successful results, and cases of complete failures are less frequent than by any other.

PREPARATION OF INSTRUMENTS.

Formerly, I took all the precautions necessary for thorough sterilization by boiling in water and by dry heat in a sterilizer; these extra precautions I found resulted in destroying instruments and did not improve my statistics. I long ago (ten years) returned to cleansing my instruments in diluted alcohol (alcohol ʒi, aquæ destillata ℥iii); after immersing them in this solution for five minutes they are then carefully dried with sterilized gauze.

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[3] Ophthalmology, January, 1907.

Here I wish to enter a protest against the introduction of metallic handles for knives and cystitomes as a substitute for ivory. An instrument having a metallic handle can not be held by fingers and thumb with the same lightness and delicacy of touch as one having an ivory handle. In an operation so important as the removal of cataract, what conscientious surgeon hesitates to obtain the best instruments of the choicest mechanical finish to aid him in making such operations a surgical success, especially since we have the means of making these refined instruments clean, preserving their cutting edge, and not destroying them by heat and chemicals before their work is accomplished?

Drs. Weeks and Landolt have called attention to the incision for the easy delivery of the cataract. I have described the accuracy of manipulation of the iris in securing the ideal keyhole iridectomy; the opening of the capsule, by many instruments devised for the purpose, vertical and horizontal crosses, peripheral incisions, and extracting the anterior leaf with capsular forceps; the delivery of the lens within its capsule and without, not even forgetting the flushing of the anterior chamber to clear this space of all cortical matter or filling the globe with a saline solution where much vitreous has been lost. All this should be done with a gentleness of touch and with delicate instruments "so that nothing be effected by force which can be accomplished by art."

NEUROFIBROMA OF THE ORBIT-KRÖNLEIN OPERATION.*

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Cases of neurofibromata (pseudo-neuromata, solitary neuromata) of the orbit are extremely rare, there being but two cases on record. Of these, one reported by Tersch[1] involved the lachrymal branch, and one reported by Marchetti[2] the infraorbital branch of the fifth nerve. The ophthalmic division of the fifth nerve has been involved in multiple neuromata, and Bietti[3] has described amputation neuromata of the ciliary nerves after optic-ciliary-neurotomy. Houel[4] has described small tumors of the third, fourth, nasal and frontal branches of the fifth nerve, found postmortem, which had never caused clinical symptoms.

The extreme rarity of neurofibromata is shown by the following statement of Tersch: "A solitary neuroma is altogether a rare tumor and its location in the orbit appears at least a curiosity;" and of Marchetti, who, after eliminating the plexiform neuromata as described by Billroth and others, says: "The exposition of the case shows its importance; a tumor rare as a pathologic type and unique in consideration of the place of its development. In fact, in the literature which I have been able to consult I have found no example of tumors developing through the infraorbital nerve."

A short review of the two published cases will be given in this paper, and a report added of a tumor of similar nature removed by me. The whole will be treated from a clinical standpoint, referring those who are interested in the detailed pathologic findings to the reports of Tersch and Marchetti.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

[1] Arch. f. Ophth., 1902.
[2] Ann. di Ottalmologia, 1904, xxxiii.
[3] Arch. f. Ophth., 1900.
[4] Lagrange: Etudes sur les tumeurs de l'oeil.

MARCHETTI'S CASE.—*History.*—Male, aged 30. At the age of 5 the mother first noticed on margin of lower lid a nodule of reddish color with smooth surface. At the end of one year it had acquired the size of a cherry, producing lagophthalmus.

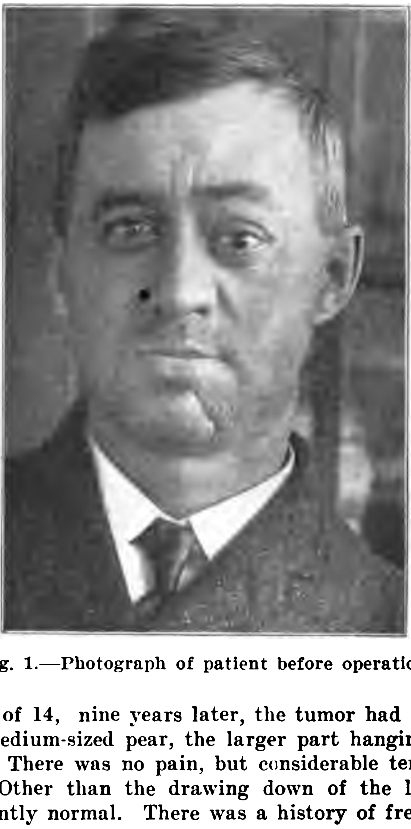

Fig. 1.—Photograph of patient before operation.

At the age of 14, nine years later, the tumor had reached the size of a medium-sized pear, the larger part hanging down on the cheek. There was no pain, but considerable tenderness on pressure. Other than the drawing down of the lid, the eye was apparently normal. There was a history of frequent hemorrhage following a slight abrasion. The tumor gradually increased in size and extended upward and backward into the orbit with final loss of function of the eye. The skin covering the tumefaction, at first but slightly changed, now assumed the aspect of elephantiasis and secreted a considerable quantity of limpid fluid. The tumor became extremely sensitive with frequent shooting pains extending over brow and head. Intellectually, the patient was subnormal, of fairly robust appearance and otherwise healthy. Family history negative. The tumor finally assumed the size of the head of a newborn child, extending downward beyond the chin with the stem rather large, extending into the orbit. The arch and inner wall of the orbit were normal; the outer wall, however, was pressed outward one and one-half centimeters. The lower wall could not be examined. The eye, greatly changed in appearance, was crowded upward and forward. The orbit was filled with a mass which was continuous with and formed part of the tumor. It was hard, apparently of a fibrous nature and covered with thickened skin which was movable on the growth. The orbital portion was slightly movable.

Operation.—In May, 1900, under chloroform anesthesia, the tumor, together with the eye, was extirpated without difficulty, there being no attachment to the orbital wall. Recovery was uncomplicated. The lower orbital wall was found converted into a groove in which the neck of the tumor rested.

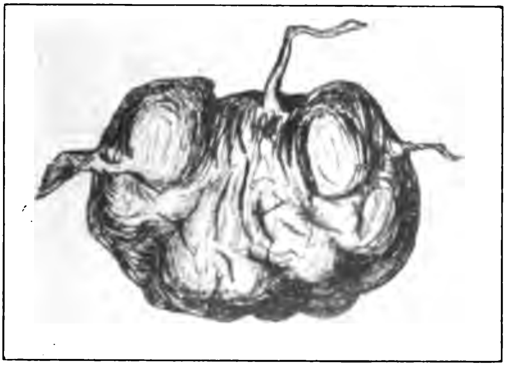

Fig. 2.—Tumor 1½ times natural size.

Macroscopic Examination.—The tumor was found to consist of two portions well differentiated one from the other. The orbital portion about the size of a fist, egg-shaped, with well defined capsule. On the anterior surface was the eye, greatly modified. The lower part of the posterior surface was surrounded by branches of the infraorbital nerve, which were normal in appearance and size and so intimately connected with the tumor that they could not be removed from it without tearing. Attached to the lower and outer part of the orbital tumor was the mass which protruded on the cheek.

Microscopic Examination.—Only the orbital portion, it was found, could be considered as the tumor proper, the lower part being exclusively represented by the characteristics of elephantiasis of the skin.

After a detailed description of the tumor, together with the microscopic findings, the author made the diagnosis of false neuroma.

TERSCH'S CASE.[1]—*History.*—Female, aged 43. Three years previously the patient noticed that the unaffected eye was deeper in and higher up than its fellow. A diagnosis of retrobulbar tumor was made and operation advised, but this the patient refused. The condition remained the same for two and one-half years, when the tumor began to grow rapidly. The patient then consented to an operation.

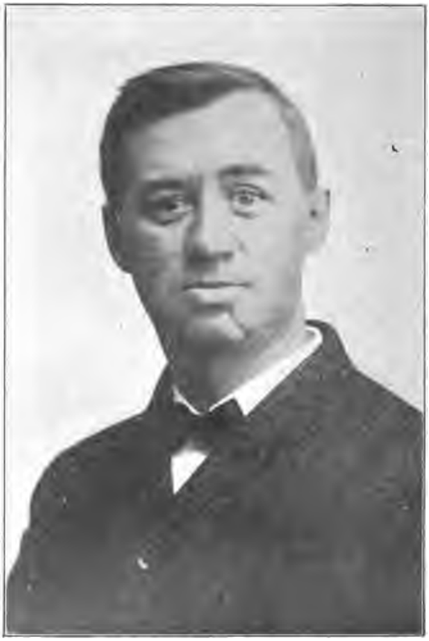

Fig. 3.—Photograph of patient taken six months after operation.

Examination.—Behind the upper lid of the right eye could be felt a resistant tumor, which rested on the bulb like a cap, extending from the trochlea to the lachrymal gland without being attached to either. The finger could be easily forced between the tumor and the eyeball. The tumor pushed the eyeball down and out, so that the upper limbus of the cornea was on a level with the lower pupillary border of the other eye. The exophthalmus was 12 mm. The movement of the eyeball except upward was free. Left eye normal. Fundi normal. Examination revealed no other tumor or swollen lymph glands. Patient was not examined for disturbances of sensibility in the fifth nerve areas, but had no pain or parasthesias.

Operation.—The operator, Professor Fuchs, made an incision parallel to the eyebrow, and, entering the orbit, removed a rather large tumor, apparently a lipoma, which semed to be sharply circumscribed. Removal was not difficult, the growth being connected with the surrounding tissue merely by a few thin strands. No other tumor could be palpated. The wound healed readily. There resulted a slight ptosis. Exophthalmos disappeared and the eyeball receded. After six months the patient appeared normal, the two eyes similar in appearance, and no further tumor formation noted.

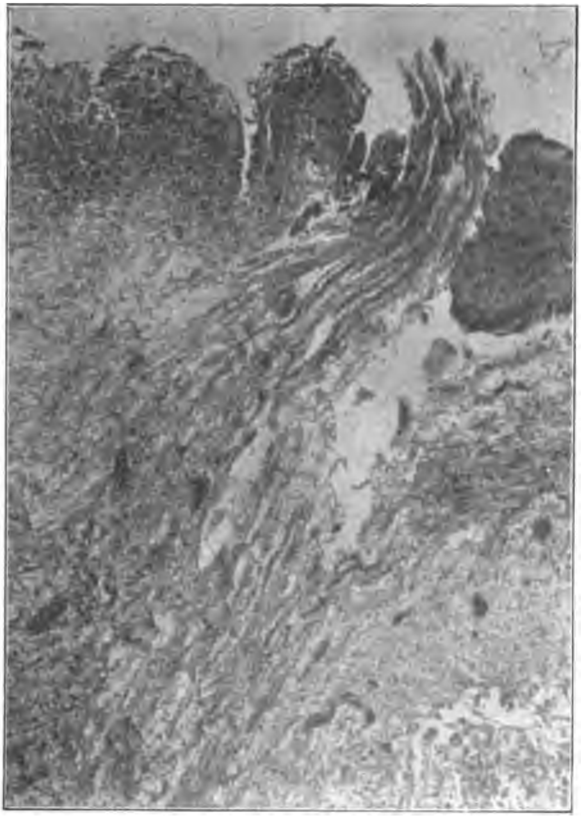

Fig. 4.—Photomicrograph of tumor showing entrance of nerve (x24).

Examination of Tumor.—The tumor appeared egg-shaped, 3.5x2.75x2.5 cm. in size, of soft consistency, yellow color, lobulated upper surface. A distinct capsule could not be seen macroscopically. On account of its consistency, the tumor was diagnosticated a lipoma. At one pole of the tumor a nerve was found entering the growth.

According to the pathologic and histologic findings, there was no doubt that the growth was a so-called pseudo-neuroma (neurofibroma), which is called in the literature a solitary neuroma. It was difficult to decide from which nerve the new growth sprang; but the author, by exclusion, concluded that it was a neuroma probably of the lachrymal branch of the fifth nerve. So much for the two cases on record.

THE AUTHOR'S CASE.—*Patient.*—Male, aged 28, referred to the ophthalmologic clinic from the oto-laryngologic clinic of the University of Michigan, in November, 1906.

History.—The patient gave a history of exophthalmus of the left eye, gradually increasing during the preceding twelve years. He had been subject to attacks of acute mania during the past six years. There was present no pain nor discomfort in the eyes except from double vision, which was especially noticeable if looking upward. No fundus changes. Vision about 20/30. The patient being illiterate and mentally substandard, accurate results could not be obtained.

Examination.—The skin of the upper lid as well as that surrounding the orbit was normal. Deep in the orbit could be felt a resistant tumor which seemed to surround the bulbus, but was found not to be attached to it. It was difficult to determine before the patient was anesthetized whether the tumor was movable or not. No well-defined demarcation between the tumor and the superior orbital wall could be felt. The exophthalmos was marked, outward about 12 mm. and downward so that the upper margin of the cornea was on a level with the lower pupillary margin. The movements of the globe, with the exception of upward, were normal. Right eye normal. Fundi normal. Patient was of medium stature and except for his mental condition, apparently healthy. The lymphatic glands were not enlarged, and with the exception of a small nodule on the brow, there were no other tumors of the skin or other parts of the body. Examination of the sensibility disturbance of the trigeminus branch was unsatisfactory. A nodule, about the size of a cherry, was situated on the brow just above the supraorbital notch. With the idea that there might be some relation between this nodule and the orbital tumor, it was determined to remove the nodule and submit it to examination. When removed, it had every appearance of a lipoma. A preliminary report from the pathologic department was fibroma, possible neurofibroma. Deep palpation while the patient was under ether revealed the fact that the orbital tumor was movable.

Diagnosis.—The following diagnostic points concerning the orbital tumor were obtained: 1. A non-malignant growth as revealed by the history and pathologic report. 2. The displacement of the globe outward and downward indicated that the tumor was situated outside and above the muscle cone. 3. It was movable.

Operation.—It was decided to attempt the removal of the orbital tumor after the method of Krönlein. A curved incision was made beginning over the temple, extending along the outer margin of the orbit, dividing the periosteum, and backward along the upper edge of the zygomatic arch. The periosteum lining the inner side of the outer wall of the orbit was resected, together with the orbital contents. The lateral wall of the orbit was cut through with a chisel in two places, above, in the suture between the great wing of the sphenoid and the malar bone, and below in a horizontal plane passing outward in a line directly above the insertion of the zygomatic arch. This piece of bone with its muscle and cutaneous attachments was forced backward, giving free access to the orbit. The periosteum was divided in a horizontal direction and the tumor then extirpated without difficulty. After removal, the periosteum was sutured with catgut, the bone and soft parts replaced, and the skin sutured with silk. Union was perfect and recovery uninterrupted. The excursion of the eye became normal and the vision remained the same as before the operation.

Macroscopic Examination.—The tumor was somewhat kidney-shaped and measured 35x25x9 mm. The surface was nodular and had the appearance of a lipoma. Protruding from the tumor were three nerves, which a careful examination seemed to prove to be the frontal externally, the supratrochlear below, and the supra-orbital nasally. When held before the light, the larger nerve was seen to divide into two branches, and the course of each could be traced through the mass. The tumor apparently had its origin in the sheath of the frontal branch of the ophthalmic at the junction of the supratrochlear and supra-orbital nerves.

Following is the report from the pathologic laboratory, for which I am indebted to Professor A. S. Warthin:

Microscopic Examination.—Tumor consists of fibrous connective tissue loosely arranged in moderately coarse fibrils with large areas of a more finely fibrillar connective tissue, resembling edematous connective tissue. The spaces between the fine fibrillæ are large and contain a finely granular precipitate. The appearance is that of an edematous fibroma. Running through the center of the mass of connective tissue are nerve fibrils, in part connected as in a nerve trunk, but for the greater part separated by connective tissue. These nerve fibrils show no increase in size, and appear normal. The connective tissue hyperplasia is limited chiefly to the connective tissue of the pari- and epi-neurim, that of the endo-neurim being affected to a less degree. The growth is poorly supplied with vessels, the veins showing a chronic congestion.

Diagnosis.—Edematous neurofibroma. (Fibromatosis of nerve trunk).

Considering the three cases as a class, there are some peculiar similarities. Two of the cases were substandard mentally, suggesting the possibility of similar intracranial nodules. In two the tumors were diagnosticated macroscopically lipomata. In all three the pathologic findings were the same, although in one there was elephantiasis of the lid.

As regards the method of operating, I believe that if the exact condition present had been known the tumor could have been removed from above, as was done in the Tersch case. No procedure, however, could have been more satisfactory than the Krönlein operation, and it offers better opportunity to meet any complications that may be present.

METASTATIC CONJUNCTIVITIS IN GONORRHEA.*

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Although gonorrhea was known to the ancients and ophthalmia neonatorum to the early Greeks and Arabians,[1] the true relation of the parent disease to its affiliated inflammations of the eye was still very imperfectly understood even at the beginning of the eighteenth century. While many of the primitive physicians appear to have fully recognized the ophthalmia of infants, it was not until 1750[2] that it was believed to depend on the vaginal discharge of the mother. Before this the theories as to its origin were rather vague, the old physicians of India, for example, ascribing it to the bad character of the mother's milk. In later years the ophthalmia of adults was thought by some to be due to gonorrheal virus seeking another outlet in consequence of suppression of the urethral discharge. Acting on this view Jüngken[3] recommended, in his text-book, the reestablishment of the flow from the urethra as the proper treatment for the ocular disease.

Without citing all the views and opinions in regard to gonorrheal affections of the eye which were in vogue before 1700, it will suffice to state that nearly all of them contained a belief in an internal or indirect route by which the venereal virus reached the eye in contradistinction to a direct or external route. This endogenous conception of the origin of gonorrheal affections of the eye prevailed until the time of Astruc,[4] who, in 1736, published the report of a case of purulent conjunctivitis which he attributed to direct infection, by the hands, from the urethra. This new theory made very slow progress. Although it was greatly strengthened in the beginning of the nineteenth century by the support of Jaeger, by the publication of Allan[5] and the lectures of Mr. Abernethy[6] at St. Bartholomew's Hospital, it did not supersede the old belief entirely until the experiments of Piringer[7] firmly established the direct causative relationship between the infecting material of the urethra and the inflammation of the conjunctiva.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

[1] Hirschberg (J): Geschichte der Augenheilk., 1899, xii, 397, of Graefe-Saemisch Handbuch der gesamten Augenheilkunde, 2d Ed.

[2] Guellmaiz: Ref. in Graefe-Saemisch Handbuch, etc., 2d Ed., v, chap. iv, p. 238.

[3] Jüngken: Die Lehre von den Augenkrankheiten, Berlin, 1832, p. 252.

After the convincing proofs of this investigator were known, the pendulum soon swung to the extreme, and it was not long before Ruete[8] and Arlt[9] maintained that all gonorrheal affections of the conjunctiva were the result of direct inoculation. While this was the prevailing belief, Fournier,[10] in 1866, described a type of conjunctivitis, occurring in a gonorrheic with inflamed joints, which he regarded as metastatic. In 1881, Haab[11] reported a case of bilateral conjunctivitis, which he saw in a patient with gonorrhea and which he thought was not due to direct infection on account of the absence of gonococci in the conjunctival secretion. In 1885, Haltenhoff[12] reported five cases of gonorrheal conjunctivitis without inoculation. In the following decade and a half appeared similar publications by Rückert,[13] Liebrecht,[14]

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[4] Astruc: De morbis Veneris, 1736, 192. Lutetiæ Parisiorum.

[5] Allan: System of Pathological and Operative Surgery, Edinburgh, 1819, i, 153.

[6] Abernethy: Lancet, London, 1825, p. 5.

[7] Piringer: Die Blennorrhoe am Menschenauge. Gratz, 1841.

[8] Ruete: Lehrbuch der Ophthalmologie. Braunschweig, 1845.

[9] Arlt: Die Krankheiten des Auges, Prag, 3d Ed., 1854, i, 45.

[10] Fournier: Nouv. Dictionaire de Méd. et Chir. pract., réd. par Jaccoud, Paris, 1866.

[11] Haab: Cor.-Bl. f. Schweiz. Aerzte, 1881, No. 4, 105.

[12] Haltenhoff: Ueber Conjunctivitis gonorrhoica ohne inoculation. Archiv f. Augenheilk. von Knapp u Schweigger, 1885, xix, 103-120.

[13] Rückert: Ueber Iritis, Conjunctivitis, Poliarthritis gonorrh. Klin. Monatsb. f. Augenh., 1886, xxiv, 339-358.

[14] Liebrecht: Kasuistiche Beiträge aus Prof. Schöler'schen Augenklinik, Klin. Monatsb. f. Augenh., 1891, xxix, 176-179.

Vanderstraeten,[15] Parinaud,[16] Morax,[17] Lipski,[18] Nobl,[19] Gielen,[20] Becker,[21] Lichtenstern,[22] Fage,[23] Morton[24] and others. In 1899, the subject was brought before the Ninth International Congress of Ophthalmology by Van Moll,[25] of Rotterdam, who reported six cases of his own observation. Kurka,[26] in 1902, published an account of twenty-two cases, two of which were seen by him in Professor Fuchs' clinic in Vienna and the others were taken from the literature. Later cases have been reported by Lesser,[27] Apetz,[28] Thorner,[29] Sym,[30] Paul,[31] Burnett[32] and others.

In reviewing the text-books, I find that few give any space to metastatic gonorrheal conjunctivitis. The silence of many authors on this subject may be due to the fact that the field of ophthalmology has become so vast that it is almost impossible to cover it entirely without omitting one of the less frequent diseases. Of thirty-four books on the eye which have appeared in English, either as the original or as a translation, during the past

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15. Vanderstraeten: Des affections oculaires de nature blennorrhagique. Arch méd. belges, 1891, xi, 300.

16. Parinaud: Congr. d'Opht., Paris, 1891.

17. Morax: Recherches bactériologiques sur l'étiologie des conjonctivites aigues et sur) l'asepsie dans la chirurgie oculaire, Thèse de Paris, 1894.

18. Lipski: Des complications oculaires métastatiques de la blennorrhagie, Thèse de Paris, 1895.

19. Nobl: Ueber seltenere Komplicationen der Blennorrhoe. Allg. Wiener med. Zeitung, 1895, No. 33.

20. Gielen: Ueber gutartige doppelseitige Conjunctivitis nach Affectionen der Urethra. Diss. Bonn., 1897.

21. Becker: Die metastatische gonorrhoische Augenbindehaut-Erkrankung. Jahresb f. Natur- und Heilkunde, Dresden, 1897-98.

22. Lichtenstern: Zwei Fälle von gonorrhoischer Allgemeininfection. Prager med. Wochschr., 1898, No. 43.

23. Fage: Conjonctivite blennorrhagique métastatique, Recueil d'Opht., April, 1900.

24. Morton: Relation of Certain Catarrhal and Suppurative Inflammations of the Conjunctiva to Urethritis and Arthritis. Ophthalmic Record, June, 1900.

25. Van Moll: Giebt et eine metastatische Conjunctivitis? ix Internat. Congr. of Ophthal., Utrecht, 1899.

26. Kurka (A.): Ueber metastatische Bindehautentzündung bei Gonorrhoe. Wien. klin. Wochschr., 1902, No. 40.

27. Lesser: Conjunctivitis duplex rheumatica nach Gonorrhoe. Münch. med. Wochschr., 1902, No. 29.

28. Apetz (W.): Ueber gonorrhoisch-metastatische Entzündung am Auge Erwachsener. Münch. med. Wochschr., Aug. 4, 1903.

29. Thorner: Ueber metastatische Conjunctivitis gonorrhoica. Charité Ann., Berlin, 1904, xxviii, 340-347.

30. Sym (W. G.): Metastatic Gonorrheal Ophthalmia. Edinburgh Med. Jour., 1904, 126-129, vol. xvi.

31. Paul: Metastatische-gonorrhoische Augenaffektion. Berl. klin. Wochschr., 1905, No. 9.

32. Burnett (S. M.): Inflammation of the Eye Due to the Toxin of the Gonococcus. THE JOURNAL A. M. A., 1905, xlv, 1926-1928.

twelve years, the disease is given in seven, being mentioned in two (Ramsey, Swanzy and Werner) and described in five (Fuchs, Schmidt-Rimpler, Lawson, Norris & Oliver's System, de Schweinitz). Many textbooks, too, on genitourinary diseases fail to mention it, though Taylor, Fuller, Keys, White and Martin have a description.

One naturally hesitates to report as few as two cases, even though they furnish the main reason for this paper, which is to give the ophthalmologists of the Association an opportunity to express their views on a subject which, so far as I can learn, has never before been formally presented to the Section. A free discussion may do much to make this form of conjunctivitis better known, may help to determine the frequency of this disease in our country, may be the means of dispelling doubts which, I fear, still remain in the minds of some as to its existence, and may possibly suggest to some one a line of work for original investigation.

Case 1.—T. C., white, aged 35, was in the second week of a first attack of gonorrhea, when his right eye became inflamed.

Examination.—Patient, with no history of rheumatism, came under my observation for the first time Jan. 19, 1905, at St. Joseph's Hospital, Baltimore, his ocular trouble having existed about ten days or two weeks. There was at that time photophobia, lachrymation, some soreness about the eye, but no decided pain, no swelling of the lids, pronounced injection of the conjunctiva of the eyeball with slight swelling, the episcleral vessels being well filled. There was a moderate amount of mucopurulent secretion; cornea, iris and deeper parts were in good condition; vision was not affected; the left eye was normal.

Subsequent History.—The right ankle had begun to swell and to give pain twenty-four hours previously, and two days later the patient suffered severely from pain in the region of the sacrum, which was in turn followed by pain and swelling of the right knee, and pain but no swelling of the right wrist. The inflammation of the right conjunctiva subsided under local treatment in about eight days. A day or so after the patient was first seen a Buller's shield was placed over the left eye to prevent any possible infection from the urethra or from the right eye. Under this protection the eye began to show signs of conjunctival inflammation three weeks after the other became diseased. The character of the conjunctivitis on the left side was identical with that on the right, but its course was shorter, due, probably, to the influence of earlier treatment. Pain and swelling of the left ankle and pain in the left wrist followed quickly on the onset of conjunctivitis on the left side.

When this seemed almost well the patient was taken with pain in the left eye, accompanied by marked increase of redness of the eyeball, ciliary injection, and hyperemia of the iris. The pain soon became severe and the aqueous muddy; the pupil dilated imperfectly under atropin, showing three small posterior synechiæ. The anterior chamber became one-quarter filled with blood; the pupil was obscured by dull grayish deposit and the fundus was invisible. The eyeball was very tender to slight pressure and vision was reduced to counting fingers at four feet. The iritis lasted five weeks. The exudates slowly became absorbed and vision returned to 20/20. At one time during the course of the iritis on the left side the right eye became painful, showing some ciliary injection and discoloration of the iris. Atropin was used freely and no further developments were noted.

Bacteriologic Examination.—Coverslips alone were used. Pus from the urethra showed gonococci. Secretion from the conjunctival sac of each eye was repeatedly examined but always with negative results.

The case at first presented a complex of symptoms with which, I confess, I was not altogether familiar. It seemed perfectly clear that the condition was not gonorrheal ophthalmia or acute blennorrhea, and its resemblance to acute catarrhal conjunctivitis was not borne out by other clinical phenomena present, as gonorrhea and arthritis. The diagnosis of metastatic conjunctivitis was based on the following points: (1) the existence of a urethritis with gonococci, (2) the character of the conjunctivitis, (3) the absence of gonococci in the conjunctival secretion, (4) the presence of polyarthritis.

Case 2.—J. H., white, aged 39, was referred to me by his family physician, Dr. W. T. Riley, March 5, 1907. The patient, with no history of rheumatism, was in the fourth week of a first attack of gonorrhea, involving both anterior and posterior portions of the urethra and producing prostatic enlargement and swelling of the seminal vesicles.

History.—The trouble started March 1, in both eyes simultaneously, with mild photophobia, lachrymation, redness, and slight secretion. Accompanying the onset of the ocular symptoms were frontal headache, vertigo, coated tongue, loss of appetite, chilly sensations, temperature 100 F., occasional sweating, pains in the lumbar region, in the right leg above the internal malleolus and in the larger phalangeal joint of the middle finger of the right hand. The eyes soon became worse, the lids being stuck together in the morning and the eyeballs more "bloodshot."

Examination.—The patient came under my observation on the fourth day, the condition then being about as follows:

Marked injection of the conjunctiva, limited almost entirely to the fornix and globe, some swelling of the conjunctiva, particularly in the region of the limbus; several small conjunctival hemorrhages in each eye; episcleral vessels congested; moderate amount of mucopurulent secretion; no swelling of the lids; cornea and iris good; pupils small, though responding well to light; vision 20/30 in each eye, the slight impairment being due to myopic astigmatism.

Subsequent History.—Next day the eyes were worse, chemosis of the conjunctiva being rather prominent. The iris too showed for the first time unmistakable signs of inflammation. The pupils failed to react to light or fully to atropin, and vision sank rapidly to counting fingers at three feet. At the end of the first week the swelling of the conjunctiva was much less and there was hardly enough secretion in the conjunctival sac to get a smear for coverslip examination. The iritis, on the other hand, was rather more active; the aqueous was somewhat cloudy; there was a slight exudate in the pupillary area; the pupils were small and irregular, showing four or five posterior synechiæ in each eye, no precipitates were discernible on the posterior wall of either cornea; fundi were invisible. Pain in middle finger and leg on the right side was about the same. The patient about this time began to complain of pain in the left ankle, which was not severe and not accompanied by any swelling. At the end of the second week the iritis was still prominent. Fair dilatation of the pupils had been secured by the frequent use of atropin; the eyeballs were somewhat tender on palpation; there was no pain in the eyes, but dull frontal headache was occasionally felt. At the end of the third week there was improvement in the urethritis, in the inflammation of the eyes, and in the general condition of the patient, although pain was still present in the lumbar region, made worse by moving in bed.

During the fourth week the eyes made little or no advance toward recovery. In the following week improvement was rapid and by the middle of the sixth week the eyes were practically free from inflammation and vision was normal with the assistance of minus cylinders to correct a little astigmatism.

Bacteriologic Examination.—This was made by Dr. E. H. Hayward, pathologist of St. Joseph's Hospital. Smears, taken when patient was received into the hospital on the fifth day of his conjunctivitis, showed no gonococci in the secretion from the eye, but numerous gonococci in the pus from the urethra. Coverslips were examined twice a day as long as there was any secretion in the conjunctival sac, and always with negative results. Cultures from the secretion of the eye were made on human blood serum, blood agar, hydrocele agar, and all were negative. Culture on Loeffler's blood serum showed a single

white colony of staphylococci. Culture from patient's blood on human blood serum was negative. Though arthritis was not conspicuous as in the first case, the diagnosis in the second instance was based on the coexistence of gonorrheal urethritis, the type of bilateral conjunctivitis, the absence of gonococci in the conjunctival secretion, the iritis which appeared on the fifth day, and the slight but appreciable systemic disturbance.

In reviewing the literature on the subject I find that this form of conjunctivitis has been described under various names, as metastatic gonorrheal conjunctivitis, metastatic gonorrheal ophthalmia, gonorrheal conjunctivitis without inoculation, serovascular conjunctivitis, rheumatic gonorrheal ophthalmia, arthritic catarrhorheumatic ophthalmia, etc. In order to avoid confusion, it seems wise to adopt the title given in the second edition of the Graefe-Saemisch Handbuch, namely, metastatic conjunctivitis in gonorrhea.

Although described under so many different names, the disease has been represented with the same essential characteristics. The constancy with which these clinical phenomena appear together, and the number of such occurrences, preclude the possibility of mere coincidence. A study of the reported cases, as well as of the two which came under my observation, furnishes sufficient data for a rough description of the main clinical features of the disease. The primary infection being gonococcal, the disease starts out with an ordinary purulent urethritis. Usually rather early in the course of the gonorrhea, but at times during a second or subsequent attack, a conjunctivitis appears. The inflammation involves chiefly the conjunctiva of the fornix and eyeball, giving rise to marked redness and swelling and at times chemosis. Often the episcleral vessels are engorged, showing the characteristic pinkish or violet color. The secretion is mucoid, or mucopurulent. It is usually moderate in amount and contains no gonococci. The subjective symptoms are photophobia, lacrimation, slight soreness of the eye, and occasionally pain. Vision is not affected if the deeper ocular structures are not implicated. The conjunctivitis involves both eyes, either at the same time or in rapid succession, and ends in the restoration of the conjunctiva to the normal. It usually comes on before the joints are attacked, although this order may be reversed. The inflammation is occasionally limited to the conjunctiva, but it is more often accompanied or followed by iritis or iridocyclitis. When inflammation of the uveal tract occurs, it is usually of the serous or plastic variety. Keratitis is rare, varying in degree from a small area of infiltration to ulceration. Retina and optic nerve are very infrequently involved. In consequence of these complications vision may be very much reduced, but, barring corneal destruction, it returns as the intraocular exudates are absorbed. Though arthritis is not a necessary factor of the diseased process, it is almost always present. It generally occurs in more than one joint, the larger ones being more often attacked than the smaller.

An interesting feature of the disease is its tendency to recur. A new attack of conjunctivitis, followed by pain and swelling of the joints, may appear after a fresh outbreak of gonorrhea and be equally as severe as the first. In several instances the cornea and iris have become involved in the recurring attack after having entirely escaped in the initial one. Furthermore, an increase in the urethral discharge is often the forerunner of an exacerbation of both conjunctival and joint affection. In a case reported by Rückert there were three occurrences of urethritis, two of which were followed by conjunctivitis, one by iritis. In the case of Apetz there were two recurrences and two exacerbations, in all of which the conjunctiva was correspondingly involved. A single recurrence is more frequently met.

It may not always be possible to distinguish this disease, though in the majority of cases a diagnosis offers very little difficulty. The diseases which come into question are acute blennorrhea or gonorrheal ophthalmia of the adult and actue catarrhal conjunctivitis. The clinical picture of a typical case of the former is sufficiently characteristic to leave no doubt as to diagnosis, the tensely swollen lids, the greatly infiltrated conjunctiva, the profuse flow of pus containing gonococci being in marked contrast to the bilateral affection of metastatic origin with soft lids, relatively smooth conjunctiva of the lid and moderate mucopurulent secretion containing no gonococci. The diagnosis, however, must be made with care on account of the possibility of the case in question being one of mild gonorrheal ophthalmia, in which the virulence of the urethral infection was greatly weakened before the eye was inoculated. In such, an early bacteriologic examination of the conjunctival secretion will usually reveal the gonococcus, thus establishing the exogenous character of the inflammation. If, however, no gonococci are found, the existence of a metastatic arthritis or iritis will point to an endogenous infection of the conjunctiva.

From an acute catarrhal conjunctivitis the differentiation is not so easy if we regard the ocular condition alone. However, the localization of the inflammatory process, more in the conjunctiva of the fornix and eyeball than on the lid, and the presence of a deep episcleral injection, will strongly suggest metastatic conjunctivitis. The coexistence of gonorrhea will be additional evidence, and should an arthritis be present the diagnosis will no longer be in doubt, because metastases never exist in genuine catarrhal conjunctivitis. Even without metastatic joint inflammation the diagnosis may still be made by finding gonococci in the circulating blood.

Can simple iritis or iridocyclitis be mistaken for metastatic conjunctivitis? The congestion of the eye, if taken by itself, may not always be sufficiently characteristic to enable one to distinguish between the two, but if the patient is seen early, swelling and chemosis of the conjunctiva and mucopurulent secretion will exclude simple iritis with certainty. If, however, the patient is seen late, when the conjunctival symptoms proper have become less marked or are obscured by the involvement of the uveal tract. it may be no longer possible to tell from ocular appearances alone whether the initial inflammation was in the conjunctiva or in the iris. It goes without saying that in those cases of metastatic conjunctivitis in which no part of the uveal tract becomes involved iritis does not enter into the question of differential diagnosis.

All reported cases of metastatic gonorrheal conjunctivitis have occurred in men. Whether any reason exists for this in the anatomy of the male urethra and its adjacent organs it is difficult to say. Many authorities claim that systemic infection occurs more often through the prostatic portion of the urethra, while, according to Fuller, the seminal vesicles constitute the route frequently taken by the gonococcus or its poison in entering the general circulation.

The old belief of gonorrhea being purely a local disease has been made untenable by modern investigators, who have found gonococci in the circulating blood (Wertheim), in the fluid of arthritic joints, and in the heart (Thayer). The prevailing and well-proven belief is that, in addition to the local urethritis, gonorrhea may produce systemic lesions by the transportation of infectious material through the lymphatic or blood channels from the original seat of disease to distant parts of the body. In full accord with this are the clinical reports of gonorrheal complications which appear in the literature. Besides arthritis, we have well-authenticated cases of gonorrheal pericarditis, endocarditis, myocarditis, pluritis, nephritis, phlebitis, myositis, myelitis, subcutaneous abscess, general septicemia, diseases of the peripheral and central nervous system, and lesions of the skin. With this advance in knowledge before us regarding gonorrhea in its relation to the general system, it may not be amiss to ask ourselves if we, as ophthalmologists, should not modify our views of gonorrhea in its relation to the eye. Such a suggestion seems all the more timely, as many authors of text-books on ophthalmology give iritis alone as a possible metastatic complication of gonorrhea. Since Mackenzie first recognized gonorrheal iritis, reliable publications have appeared from time to time of cases of metastatic dacryoadenitis,[33, 34] conjunctivitis, tenonitis,[35] keratitis,[36, 37] iridochorioiditis,[38, 39] retinitis,[40, 41, 42] neuroretinitis,[43] optic

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33. Cause (F.): Metastatische Tränendrüsenentzündung bei Gonorrhoe. Ztschr. f. Augenh., 1904, xi, 399.

34. Panas: Dacryoadénite, iritis, et conjunctivite séro-vasculaire d'origine blennorrhagique. Jour. des Prat, Feb. 21, 1894.

35. Puech: Un cas de ténonite. Clin. ophth., January, 1895.

36. Martin: Recherches anatomo-pathologiques sur les inflammations métastatiques à la suite de la gonorrhée. Génève Diss. Ref. in Arch. f. Augenheil., xiv, 117.

37. Burchardt: Entzündung der Iris, der Hornhaut, der Sehnervenscheibe und der Netzhaut infolge von Gonorrhoe. Charité Annalen, 1897, 345.

38. Bull (C. S.): Systemic and Constitutional Character of Gonorrhea, illustrated by five cases of iridochorioiditis. Med. Record. 1902, lxii, No. 25.

39. Galezowski: Des irido-chorioidites gonococciques. Progrès Méd., January, 1905.

40. Burchardt: Entzündung der Iris, des Strahlenkörpers des linken Auges, Netzhautentzündung beider Augen, und mehrfache Gelenksentzündungen nach Gonorrhoe, Charité Annalen, 1894, 246.

41. Galezowski: Sur les altérations vasculaires de la rétine dans l'infection blennorrhagique. Ann. d'Oculist, 1900, i, 301.

42. Hilbert: Retinitis infolge von gonorrhoischer Infektion. Ztschr. f. prakt. Aerzte., vii.

43. Highet: Case of Neuro-retinitis. Abst. in Med. Bull., Phila., April, 1896.

neuritis,[44] and panophthalmitis,[45] all depending primarily on gonorrheal infection. In point of frequency, iritis is the most common, occurring, according to De Lapersonne, once or twice in 7,000 eye cases and conjunctivitis next. Kurka saw 2 cases of this in 20,000 patients frequenting Professor Fuchs' clinic in one year.

The work of investigators in determining the infecting material which brings about this metastatic conjunctivitis, and in establishing its relationship to the underlying disease has not been rewarded with uniform results. As a consequence three theories have arisen:

1. Some authorities maintain that the inflammation is due to the presence of the gonococcus in the conjunctival sac, the organisms being carried thither by the blood vessels. This is supported by the bacteriologic examinations of Lipski, Morax, and Van Moll, who found the gonococcus in the conjunctival secretion. The experience of these three observers is almost unique, as the great majority have failed to find the specific organism. In a review of 30 bacteriologic examinations of reported cases I find that 26 showed no gonococci in the conjunctival secretion, 3 gave the organism in small numbers, and 1 examination was doubtful. Adding my 2 cases makes a total of 32 examinations, 28 being negative, 3 positive and 1 doubtful. Kurka, thinking the gonococci might be under the epithelium, excised a piece of conjunctiva from one of his patients and examined it microscopically, but was unable to detect the organism. The advocates of this theory bring to its support the investigations of Kämmerer, Petrone, von Lindemann, Höck and many others who have found gonococci in the fluid of arthritic joints, arguing by analogy that the same infection occurs in the conjunctiva. While the bacteriologic examinations made in cases of metastatic conjunctivitis are not conclusive, it seems probable, in view of the inability of the great majority of observers to find the gonococcus in the conjunctival secretion, that some other infective agent must be the principal one in this inflammation.

2. The second theory is that the conjunctivitis is the result of mixed or secondary infection; that the gono-

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[44] Panas: Névrite optique d'origine blennorrhagique. Presse Méd., 1895, 64.

[45] Galezowski: Irido-chorioidite avec névrite optique et panophtalmie dans une méningite cérébro-spinale gonococcique. Rec. d'Opht., Paris, 1903, xxv, 309.

coccus does not play the important rôle, but rather prepares the soil for another organism as the staphylococcus, the streptococcus, or the pneumococcus. Van Moll found the first in the conjunctival secretion of five out of his six cases, and, inasmuch as the staphylococcus has been frequently found in the fluid of gonorrheal joints, he concluded that the conjunctivitis was probably a mixed infection in which the staphylococcus was the chief agent. To this it may be objected that staphylococci are often found in the normal human conjunctiva and that, as Axenfeld has said, they show themselves in the conjunctival sac at the slightest irritation, even when they are not the exciting cause. Many authorities who adhere to the theory of mixed infection base their belief largely on those experiments made on gonorrheal joints in which the gonococcus was not found, but in which the staphylococcus was the organism in evidence. Conclusions, however, from joint examinations must be drawn with care, because with the common method of aspirating joints the gonococcus, if imbedded in the synovial membrane or present in the periarticular tissues, may easily go undetected. From conversations with laboratory workers I learn that it is their experience that with modern technic and careful examination of gonorrheal metastases the gonococcus is found more frequently in pure culture than formerly, and cases of so-called mixed infection are becoming less frequent.

3. The third and perhaps the most tenable theory founded on present knowledge is that this type of metastatic conjunctivitis is not directly and essentially an infection by the gonococcus itself, but is the result of a poisonous product of this organism acting on the cellular elements of the conjunctiva. This possibility was suggested by Axenfeld in discussing Van Moll's paper at Utrecht in 1899. The majority of writers since then are more inclined to this view than any other. It seems, too, to be well supported by the experiments of Wassermann,[46] Nicolaysen,[47] Laitinen,[48] Grosz and Kraus,[49]

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[46] Wassermann: Ueber Gonococcuskulture und Gonococcengift. Berl. klin. Wochschr., 1897, No. 32.

[47] Nicolaysen: Zur Pathogenität und Giftigkeit des Gonococcus. Centrbl. f. Bact., 1897, xxii, p. 305.

[48] Laitinen: Beiträge zur Biologie des Gonococcus. Centrbl. f. Kenntnis der Bact., 1898, xxiii, 874.

[49] Grosz und Kraus: Bacteriologische Untersuchungen über den Gonococcus. Archiv. f. Derm. und Syph., 1898, xlv, 329.

Christmas,[50] Morax and Elmassian,[51] and Randolph.[52] These investigators have demonstrated that the gonococcus generates a specific active poison, the gonococcus-toxin, which is contained in the body of the organism. All of them agree that the bodies of gonococci possess this toxic material, but all do not hold that one is artificially separable from the other. Wassermann, Nicolaysen and Laitenen maintain that the poison is confined to the body of the organism, while Christmas, Morax and Elmassian and Randolph believe that it may be, at least in part, dissolved in the liquid of the culture medium. While the toxin has not been chemically defined as yet, it has been proved by biologic test to possess properties separate and distinct from those of the gonococcus. The latter is destroyed by a temperature of 40 C. (Wossidlo), while its toxin is destroyed by a much higher temperature, according to Christmas 80 C., according to Morax and Elmassian 115 C. It is very much more difficult to preserve artificially the activity of the gonococcus than that of its toxin. While it is impossible to obtain an inflammation with proliferation of the gonococcus on the animal conjunctiva, whatever the mode of inoculation, it is quite possible, according to Morax and Elmassian, to obtain an analogous condition by instilling the toxin into the conjunctival sac of the rabbit. It has also been shown that intraperitoneal as well as subcutaneous injections of the toxin have produced death in animals, chiefly guinea-pigs and white mice, and a solution of this poison has caused urethritis, differing from the genuine gonorrhea only by the absence of gonococci.

Without giving in detail the work of the various investigators of this subject, I wish to refer to the experiments of Morax and Elmassian, which were given to the Utrecht Congress of Ophthalmology and with which all members of this Section are doubtless familiar. It will be recalled that these Frenchmen experimented with the live as well as the dead cultures of the gonococcus; that they instilled into the conjunctival sac of rabbits and man an emulsion of dead gonococci and the filtered cultures of these organisms and produced an inflammatory conjunctivitis both in the rabbit and in man. That this reaction was not a mere mechanical effect was proved by control experiments. The possibility of the gonococcus having anything to do with it was excluded by boiling the medium. It seemed perfectly clear to the minds of the investigators that this artificially produced conjunctivitis was due directly to the action of the toxic substance which they dissolved from the bodies of gonococci.

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[50] Christmas: Contribution à l'étude du gonococcus et de sa toxine. Ann. de l'Inst. Pasteur, 1900.

[51] Morax and Elmassian: Du rôle des toxines dans la production des inflammations de la conjonctive. ix Congrès Internat. Ophthalmologie, Utrecht, 1899, August.

[52] Randolph: The Rôle of the Toxins in Inflammations of the Eye, Johns Hopkins Bull., Baltimore, 1903, xiv, 47-60.

The results of Morax and Elmassian might seem at first sight to be contradicted by the more recent work of Randolph in the Johns Hopkins laboratory. The latter experimented with filtrates of the gonococcus on rabbits and found that simple instillation into the conjunctival sac produced reaction in only one instance. In the animals which showed no conjunctival reaction, the instillations were continued from 15 minutes to 3 hours, while those of Morax and Elmassian were kept up from 2 to 7 hours, the majority being from 5 to 7 hours. It may be that the difference in duration of instillation may account in part for the difference in results. Randolph, however, produced a conjunctivitis in every case in which he injected the filtrate into the conjunctiva. By introducing the toxin under the epithelium he facilitated absorption and produced a local reaction more quickly than could be obtained by continuous instillation.

Although the investigators who have been working along the line of the present subject have brought to light most valuable information, they have not produced uniform results. Reasons for this are not hard to find: (1) The technic of the investigations is very difficult; (2) most animals are not affected by the gonococcus, though they seem to be susceptible to its toxin; (3) the nature of the gonococcus toxin is still very much in doubt; (4) gonorrheal metastases of the eyeball lend themselves badly to experimentation; (5) metastatic conjunctivitis being rare, opportunities for studying the disease seldom present themselves.

To me the study of this subject has suggested that perhaps better data might be furnished if the bacteriologic examination in each case of metastatic gonorrheal conjunctivitis were made early and included not only the conjunctival secretion, but also the blood, and the effusion of the joints if arthritis be present.

In conclusion, it may be suggested as a fair hypothesis in the light of our present knowledge that while it is possible, as maintained by Morax thirteen years ago, for a few cases of metastatic conjunctivitis to be caused by the gonococcus in the conjunctival sac, it is probable that the essential agent in the great majority of cases is not the gonococcus acting on the ocular mucosa, but a specific poisonous product of this organism called its toxin.

SOME CONSIDERATIONS IN THE TREATMENT OF LACHRYMAL OBSTRUCTION.*

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Before this Section it is not necessary to discuss the treatment of all the various obstructive causes of epiphora. Those cases due to psychic or reflex causes, to refractive errors or in which hypersecretion is due to other non-obstructive causes will not be considered. The treatment of those portions of the tear drainage apparatus above the lachrymal sac, being well understood, will receive but little attention. However, further consideration of the treatment of pathologic conditions of the lachrymal sac and nasal duct, especially if it leads to free discussion, seems timely, since the diverse methods now employed indicate that it is not well understood. The necessity of treating abnormal conditions in the nose will be emphasized, since they are very important in the etiology of these affections.

For purposes of treatment, I divide the tear drainage apparatus into three parts. The upper portion includes the puncta and canaliculi. The treatment of this upper part has been much discussed and is fairly satisfactory. The lower portion, an examination of which should never be neglected, and the treatment of which is often very important, is that part of the nose into which the nasal duct drains. Pathologic conditions of this part are the most common causes of inflammation of the other parts of the drainage apparatus. The middle portion comprises the nasal duct and lachrymal sac. This portion is less accessible than the others and treatment correspondingly less satisfactory.

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In beginning the treatment for epiphora, only conservative measures should be used for the middle portion—the lachrymal sac and nasal duct—until the conditions which could cause obstruction in the upper and lower portions are first corrected. The surgeon should treat these cases not only from the standpoint of the ophthalmologist, but also from that of the rhinologist.

If there is pus or mucus in the lachrymal sac—dacryocystitis—extirpation of the sac is often required, but conservative treatment should first be given a trial. The pus or mucus should be pressed out frequently. A small swab of cotton placed over the sac and inner canthus absorbs the expelled secretion so that it will not be sucked back into the sac when the pressure is removed. Antiseptic and astringent solutions dropped into the inner corner of the conjunctival sac just before removing the pressure of the finger, are easily introduced into the lachrymal sac. This, with removal of the lachrymal obstruction and treatment of the probable nasal cause, sometimes affords relief. One canaliculus should usually be slit. When there is much swelling, Risley[1] points out the special danger of making false passages until it has been reduced by cold compresses or other antiphlogistic treatment.

As the first step in the treatment of all other cases, except those in which the lids or puncta are everted or in some chronic cases of lachrymal obstruction, especially those that have been probed, I carefully dilate both puncta sufficiently to pass the smallest sized probe through the canaliculi. In order that no false passage be made, the canaliculus should be straightened as nearly as possible by stretching the lid outward with the fingers. At this stage, I do not pass the probe farther than merely to enter the lachrymal sac, but repeat the probing a few times, a day or so apart, to prevent the formation of a stricture. If in syringing, the fluid readily and without much force passes into the nose, it shows that the remainder of the drainage canal is patulous. In this case simple measures, as gentle dilatation, syringing, the use of mild astringents and massage of the sac, will likely be rewarded with a good result. Therefore, probing of the nasal duct, or other radical measures, should not be resorted to unless the epiphora persists after a careful and thorough course of treatment, and not until, as de Schweinitz[2] insists, the causative factors, obstructive and otherwise, as psychic, reflex, and those of nervous origin, are first considered.

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[1] THE JOURNAL A. M. A., Dec. 24, 1904, page 1963.

Any short hypodermic or lachrymal syringe, armed with a dull needle or other small blunt-ended canula, may be used for syringing when the canaliculi are small. A larger canula can be used when the canaliculi are dilated or after slitting. The syringe should be short and not too large, in order that the hand holding it may be steadied by resting the fingers against the forehead of the patient and so that too much force will not be required to press the piston home, which would make it unsteady, jabbing the patient and thus causing pain. J. S. Kirkendall[3] described an excellent syringe which he had made by E. B. Meyrowitz. I have had a somewhat similar syringe made by V. Mueller & Co., Chicago. Regurgitation from the opposite canaliculus can be prevented by constricting it with a small clamp placed on the lid. I directed the making of a simple clamp manufactured by V. Mueller & Co., Chicago. with which different degrees of pressure may be made. It is very light, weighing only seventeen grains, and can be readily applied and removed. W. Gordon Byers[4] recommends a canaliculus clamp which he had made by E. B. Meyrowitz. In the same article he describes a syringe nozzle which swells some distance from the end, so that when pressed home it completely stops up the canaliculus being syringed, and thus prevents regurgitation from it.

The canula should not pass farther than the lachrymal sac, and at first the syringing should be repeated every day. Syringing is most useful in cases seen early, and must be thoroughly and perseveringly done, which requires the cooperation of the patient. Any mild astringent solution, e. g., adrenalin chlorid, zinc sulphate, gr. ½ or 1 to the ounce, or some simple cleansing solution, as plain distilled sterile water, or saturated solution of boric acid, etc., may be used. In some cases of dacryocystitis, I have found very weak solutions of silver ni-

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2. Trans. Sec. Ophth., Col. of Phys., Philadelphia, 1905.
3. Ophth. Rec., October, 1904.
4. Ophthalmoscope, April, 1906.

trate very efficient, but, like its various much lauded substitutes, it is liable to produce argyrosis.

Repeated cleansing of the sac may be necessary for a week or more before the congestion is sufficiently reduced that fluid may pass into the nose, after which time the syringing is repeated at constantly increasing intervals. Indeed, patients can be taught to use a syringe themselves, preferably one with a rubber bulb. It is easier than to teach them to use a probe. If there are weak spots in the sac wall, especially after probing, syringing must be gently done or the walls may be ruptured.

If the fluid can not be made to pass into the nose, there is an obstruction either in the nasal duct or the lachrymal sac or at the outlet into the nose. It is well known how rarely the lachrymo-nasal canal becomes diseased secondary to conditions of the conjunctival sac, even when gonorrheal or diphtheritic conjunctivitis is present, but the nasal factor in the etiology of these troublesome conditions must not be overlooked (Brewerton,[4] Meyer[5]). J. Herbert Parsons[6] states that the infection generally spreads up the nasal duct from the nose, though, in rare cases, it may start in the conjunctival sac. He remarks that conjunctivitis rarely causes dacryocystitis, although the latter and rhinitis often give rise to conjunctivitis, which, in turn, excites an overproduction of tears. Byers writes:[7] "The initial changes in chronic catarrh of the lachrymal duct occur, as a rule, about the inferior meatus." At first epiphora is usually complained of when going out into the cold or wind or during a coryza, when the cavernous tissue of the nose is swollen, and later it is aggravated by the same conditions.

The slit-like outlet of the nasal duct into the nose is surrounded by cavernous tissue with its dense plexuses of vessels, often capable of such swelling as to occlude the space around the opening. It is, therefore, in a portion of the nose frequently inflamed by coryzas, where the cavernous tissue is constantly changing in bulk, in an effort to warm, clean and moisten the inhaled cold, dry and often irritating air. The tissues on the inferior turbinate bone may become so hypertrophied as to press

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5. Berl. klin. Wochschr., 1906, xxiii, 751.
6. Brit. Med. Jour., Feb. 23, 1907.
7. Ophth. Record February, 1904.

on the floor of the nose and shut off proper drainage. This also may be brought about by spurs on the septum or deflections of it, polypi or other abnormal conditions of the nose, often limited to one side, just as the epiphora is.

The mucous membrane walls of the lachrymal sac and nasal duct, continuous with the mucous membrane of the nose, like those of most ducts in the body, normally lie in contact, and are surrounded by well-developed venous plexuses connected with the cavernous tissue of the nose. It can readily be seen that inflammation of the cavernous tissue around the outlet of the duct blocking it would sooner or later cause an engorgement of the vessel plexuses which underlie the mucous membrane of the nasal duct. Therefore, inflammation easily extends from the nose to these tissues, which, when swollen within a bony canal, especially if catarrhal inflammation has also extended along the mucous lining, partially or wholly obliterate the lumen of the duct, so that more than normal force is required to press the tears through into the nose. In this way a stagnant, irritating fluid containing micro-organisms accumulates, forcing the walls of the sac and duct apart and causing them to secrete more fluid and later even mucus and pus. Tooke[8] says that a more fertile field for the production and cultivation of bacteria than a stagnant lachrymal sac is difficult to find. The walls of the sac are weakened and gradually give way to the pressure of the fluid, losing their elasticity. Therefore, in all cases, the portion of the nose into which the nasal duct empties should be thoroughly examined before treatment is commenced, and especially before passing probes or otherwise radically treating the nasal duct.

It is often difficult, even in fresh specimens, to find the outlet of the canal under the inferior turbinate, and it is usually not possible to examine the exact outlet. Much can be done, however, to relieve congestion in its locality. In many cases the epiphora may be temporarily relieved by a local application of a solution of adrenalin or silver nitrate applied by means of cotton wrapped on the end of a bent probe. In order to reduce the redundant tissue, it may be necessary to cut or cauterize through the mucosa, or even to remove a portion of it. Sometimes the anterior end of the inferior tur-

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8. Brit. Med. Jour., Dec. 22, 1906.

binate, mucous polypi or other growths should be removed, and any inflammation, hypertrophy or malformation treated, which might cause obstruction, e. g., syphilitic or scrofulous rhinitis, ulcers or scars due to syphilis or lupus. The treatment of this portion of the nose must be gentle; large scars might so pull the mucous membrane as to interfere with the nasal duct opening. Nasal sprays or washes are often very useful. Probing from below, while perhaps rarely possible, is impractical and likely to irritate and inflame the often valve-like lips of the linear-shaped opening in the mucous membrane, an opening always difficult to find.

However, if no obstruction to the drainage of tears into the nose can be discovered, or if such is removed, and still fluid will not pass, the stricture must be in the lachrymal sac or nasal duct, and in such cases is generally situated near the lower portion of the sac where the lumen is narrowest. In examining a large number of skulls, I have noted that the bony canal is seldom round, but usually elliptical or oval in shape, with its long axis from before backward, or backward and slightly inward. The lumen of the nasal duct is slit-like, its long axis more or less nearly corresponding with the lumen of the bony duct. The bony canal is seldom straight. It can readily be appreciated, therefore, that when the nasal duct is not straight, but sometimes even tortuous, a practically straight probe pushed against the mucous membrane where the duct bends is liable, unless great care is exercised, to injure the mucous membrane at this point, possibly tearing it if the point of the probe is sharp, certainly bruising it against the bony wall, and no doubt denuding it of some of its softened and swollen epithelium. It may also lacerate the subepithelial tissues and even cause slight hemorrhages in the submucous vascular tissues. It is too often forgotten that the outer lining, the periosteum, is easily inflamed by any trauma, as indicated by aching for a long time after probing, especially in rheumatic, scrofulous or syphilitic subjects. The lower end of the membranous duct leading to its slit-like opening, which is situated somewhere in the mucous membrane of the nose beneath the inferior turbinate, is probably seldom in line with the rest of the duct. Therefore, it is easily seen that a probe held in a fixed position by the bony duct is likely to irritate, congest and inflame the delicate mucous membrane of the lower end of the duct and the nasal mucous membrane near its outlet, both of which must usually be pulled out of their normal position, pressed against contiguous bone, sometimes crushed and torn by the straight probe. This passing of the probe completely into the inferior meatus—except in the cases in which it has previously been passed—is uncalled for and dangerous, often giving rise to strictures in this part and even to proliferation of granulation tissue about the mouth of the duct, which obstructs it. This may sometimes be due to adhesion of the injured and subsequently inflamed lips of the opening through the nasal mucous membrane.

I used to believe that probes were not properly employed unless they were passed completely into the nose, but in some cases I discovered that, whereas, in the beginning, after probing, I was able to syringe freely into the nose, that later, after having probed for some time, it became impossible to do this. As I pointed out in a former paper,[10] this was simply due to the formation of strictures or granulation tissue about the outlet of the duct, resulting from the irritation produced by passing straight probes through its lower crooked end. In addition, this portion of the nasal mucous membrane is probably often irritated by an abnormal discharge from the duct. It is, therefore, well to remember that, while there may be more than one stricture in a case, only one may exist, and that indiscriminate probing may cause others, and that in any case it is unnecessary and unwise to pass a probe farther than the lowest stricture.

Since most strictures of the nasal duct are at its upper end, why should not the operator, when other treatment has failed and he feels compelled to use probes, at first pass them only a short distance into the duct and then try if he can not syringe through it? If he can not succeed in syringing he can pass the probe still farther and again try syringing until successful. In this way it will frequently be found unnecessary to pass the probes down into the nose, but only a short distance into the duct, with, therefore, less danger of producing new hemorrhages, strictures or granulations in the duct or about its outlet.

Cases that require complete passage of the probe before syringing can be accomplished, often do not give good results unless due to an acute congestion of the submucous vascular tissue, which later subsides, due to a bettered condition in the nares, if luckily the mucous membrane has escaped severe injury from probes.

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[10] Lancet-Clinic, Jan. 7, 1905.

The very small probe, although it may properly be used in the canaliculus, is quite likely to produce false passages in the nasal duct (Risley[1]). On the other hand, since the membranous walls of the nasal duct normally lie in contact, there is probably little necessity for making its lumen an open drain for the free passage of infectious nasal secretions and even air, by passing probes, often larger in diameter, especially in certain directions, than the bony canal itself. The nasal duct and the urethra demand different treatment, since there is little physical analogy between the two, the undilatable bony nasal canal being nearly filled with periosteum, submucous vascular tissue and mucous membrane, structures very easily injured. I prefer medium-sized silver probes, elliptical in shape, which more nearly correspond to the usual shape of the duct and bony canal and are, therefore, more easily passed than round probes of similar size. The ends are blunt so as to injure the mucous membrane as little as possible.

Holmes[9] has well said: "Any one, if enough strength is used, can make a false passage in the nasal duct with any probe." False passages and rupture of the ethmoid cells with the formation of inflammatory tissue about the sac may result, making subsequent operation more difficult. Parsons[6] remarks that, "no matter how skilfully probing may be performed, it is almost inconceivable that grave damage will not be done." The new fibrous tissue resulting from abrasions or hemorrhages is at first elastic and resilient, but it contracts as it organizes, necessitating the further use of probes and those of larger caliber. Since the nasal duct is well supplied with sensory nerves, probing is most painful and, therefore, it is difficult or even impossible to persuade the patient to persevere in treatment. Soon the contraction of fibrous tissue, together with fresh inflammation again occludes the duct. Epiphora and regurgitation of pus have usually continued for some time before the patient again has the courage to undergo treatment. Large probes are necessary to stretch the now more resistant fibrous tissue, and Parsons[6] well says: "And so

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9. Arch. of Ophth., 1899, xxviii, No. 1.

the weary cycle goes on, epiphora and pus alternating with probes and pain."

I think the tendency at present is toward the greater use of the syringe, giving the probe a less active part in the treatment of these cases (Snyder[11]). Byers[7] finds that after several injections of a solution of adrenalin a few minutes apart, each injection reducing a part of the engorgement in the nasal duct, it is usually possible to syringe fluid through into the nose. Astringent solutions are not only helpful because of their action on the mucous membrane of the duct, but also because they tend to reduce the congestion around the oulet of the duct in the nose. a part frequently inflamed because of irritating discharge from the duct or from the free passage of probes, and usually difficult to reach with topical applications made through the nose.

I addressed a few questions to a number of prominent ophthalmologists, but can find space for the replies to only two of them.

Have you objections, and if so, what, to removal of the lachrymal sac in chronic dacryocystitis or in chronic lachrymal obstruction, where conservative measures fail to give relief?

Hubbell has never felt it to be necessary.

Snyder has no objection to the operation when necessary, but thinks few cases need removal.

Donovan advises it only after thorough treatment with large probes has failed.

Würdemann rarely fails to cure by other means, and has found it necessary to remove only two sacs.

Knapp says that the extirpation of the sac does not give perfect relief from overflowing of tears, but, of course, it cures purulent conditions.

Gifford practically never finds it necessary to destroy the sac except when the canal has been obliterated by trauma. In such cases, he destroys the sac with the Paquelin cautery, but has never extirpated one.

Hansell, when probes will not relieve after slitting the canaliculus, removes the sac.

Vail has no objection to the operation, although he thinks that nearly every case can be cured without. He says it should be urged before opening the eyeball.

Taylor says that he has no special objection to it, but has nearly always found that other measures give relief.

Theobald has none, but thinks it called for in very few cases.

Dunbar Roy, **Stricker** and **Baker** have no objection to it in cases of chronic dacryocystitis, but think it unnecessary in chronic lachrymal obstruction.

Hiram Woods has no objections, but finds that many patients decline the operation.

de Schweinitz writes that he has not only no objections, but is sure it is the proper procedure. In an accompanying letter, he says: "I have practically given up the use of probes, certainly so far as the treatment of chronic dacryocystitis is concerned."

Casey Wood writes: "I have no objection, on the contrary, I greatly prefer the operation when other means of cure have failed."

Beard answers "No, on the contrary, I resort to the operation more and more frequently as time goes on."

Wilder says he approves of the operation.

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[11] Ophthalmology, October, 1906.

Millikin, **A. E. Bulson, Jr.**, **Zentmayer**, **Lauder**, **Fox**, **Carrow**, **White**, **Howe**, **Bruns**, **Ellet**, **Melville Black**, **Reber**, **John Green, Jr.**, **Williams**, **Todd**, **Veasey**, **Risley**, **Jackson**, **Wescott**, **Conner**, **Randolph**, **Parker**, **Nelson M. Black** and **Ayers** have no objection to the operation under the conditons mentioned in the question.

Greenwood thinks it should be advised more frequently.

Prince says that he removes the lachrymal sac in all cases of chronic dacryocystitis when the patient's consent can be obtained.

Snydacker says that he considers it, if properly done, the only rational procedure in the conditions mentioned in the question.

Savage has had satisfactory results by removal of the sac.

Weeks has no objection to it, and frequently performs the operation under such circumstances.

Tooke emphatically recommends the extirpation of the sac in chronically inflamed conditions, or whenever regurgitation of pus or mucopus is maintained by obstruction in the nasal duct.

Byers writes: "In cases of chronic obstruction of the lachrymal canal in which conoservative measures have failed to give relief, and especially when the condition is associated with the formation of pus which yields cultures of highly virulent bacteria, I have not only no objection to the removal of this structure, but consider the operation expedient for the comfort of the patient and safety of his eye."

My next question was:

(*a*) *Do you consider it advisable to remove the sac and gland in one operation?* (*b*) *How often do you find it necessary to operate on the lachrymal gland after removal of the lachrymal sac?* (*c*) *In such cases, do you remove all or only a certain portion of the lachrymal gland?*

Risley has had no experience with removal of either sac or gland, and believes it to be rarely necessary.

Theobald says that he has never done either operation.

Holmes replies: (*a*) Yes, on account of one anesthesia. (*b*) He always removes both because otherwise patient suffers from "tearing" all his life. (*c*) He removes all of the gland.

Carrow: (*a*) Yes. (*b*) He always removes the gland when he operates for ablation of the sac. (*c*) All.

Greenwood: (*a*) Yes, in young people. (*b*) In middle-aged and elderly people, removes the sac only. (*c*) He removes the whole gland.

Weeks: (*a*) No. (*b*) He removes the gland after removal of the sac in a minority of cases. (*c*) He removes the orbital portion, the principal portion of the gland, and leaves the palpebral.

A. E. Prince: (*a*) Removes sac and gland at one operation if there is an excess of lachrymation. (*b*) He considers it often necessary to remove the lachrymal gland after removal of the lachrymal sac before the epiphora is completely stopped. He adds that many patients have no special trouble with epiphora after removal of the sac.

A. E. Bulson, Jr., removes the sac only, and if necessary a portion of the gland later.

Ellett has never removed the gland, but thinks that it ought to be done when the amount of lachrymation after removal of the sac is considerable.

de Schweinitz: (*a*) He does not. (*b*) He has only once found it necessary to remove the whole gland. (*c*) He sometimes removes the palpebral part of the gland.

Gifford: (*a*) Not unless the patient is going to leave for uncivilized parts. (*c*) If lachrymation continues annoying, he would remove palpebral portion of the gland, and later, if necessary, the orbital portion. He has seen one case in which hemorrhage into the orbit, with atrophy of the optic nerve, and oculomotor paralysis followed removal of the gland.

Byers (*a*) No. (*c*) The accessory portion of the gland.

Tooke answers: (*a*) No, since satisfactory results are obtained by the complete removal of the sac. (*c*) In some cases he might remove the accessory portion of the gland.

Donovan: (*a*) No. (*c*) Would remove a portion first.

Casey Wood: (*a*) He is opposed to the removal of the sac and gland at one sitting, particularly as the excision of the former very often brings about a cure without recourse to removal of the gland.

Fox: (*a*) No. (*b*) Never.

Lauder: (*b*) Never.

Jackson: (*a*) No. (*b*) He does not consider it necessary to remove any portion of the gland.

John Greene, Jr.: (*a*) No. (*b*) He has never removed the lachrymal gland.

Beard: (*a*) No. (*b*) Never. It is quite unnecessary.

Wilder: (*a*) Never. (*b*) Rarely. The lachrymation that might have been considerable before removal of the sac, because of the reflex irritation from the inflamed sac, usually grows less after extirpation.

Würdemann has never removed the lachrymal gland for such purpose.

Hansell never removes the gland except when it is the seat of a new growth.

Woods removes the gland only in malignant diseases of the orbit and would hesitate to do so for the relief of epiphora after an excision of the sac.

Dunbar Roy, Ayers, Stricker, Nelson M. Black, Connor, Williams, Reber, Wescott, Parker, Savage, Bruns, Zentmayer, Howe, White and **D. W. Stevenson** have never found it necessary to remove the lachrymal gland.

Veasey does not remove the gland and finds it unnecessary.

Vail is satisfied that the gland need not be removed. He says that if the conjunctivitis due to the dacryocystitis is cured, no epiphora will be present.

Baker has not found it necessary to remove the lachrymal gland, as patients are usually satisfied with the cure of the dacryocystitis and have not been troubled much with epiphora.

Posey writes that he has removed about thirty sacs in subjects of all ages, but has never found it necessary to remove the gland.

Todd finds that his patients receive the desired relief by the removal of the sac.

Melville Black has never found it necessary to remove the lachrymal gland, as he finds the epiphora better when the conjunctivitis disappears after removal of the sac.

Snydacker has removed the lachrymal sac fifty-two times, and while a majority of the patients complain of epiphora in cold weather, he has not thought it advisable to remove the gland.

Parsons[6] states that if syringing and other measures fail, extirpation of the lachrymal sac offers a really radical cure, and, in certain conditions, he strongly advises it.

Evans[12] says that the only effective way of treating chronic dacryocystitis, and so removing a prolific source of blindness, is by removal or obliteration of the lachrymal sac, but he believes excision infinitely preferable to obliteration.

I think that the sac should be extirpated under the following conditions:

1. When pus or mucopus can be pressed out of it, unless the disease yields to a reasonable amount of conservative treatment, which does not demand of the patient too much sacrifice of nervous energy, time and money. On account of the danger of hypopyon ulcers, the demand for removal is imperative in those whose eyes are frequently subjected to injuries, as farmers, mechanics, stone cutters and lumbermen.

2. In cases in which the decryocystitis is bilateral and the patient has already lost one eye from hypopyon ulcer, the sac should be removed on the side of the healthy eye. Axenfeld[13] states that nearly 80 per cent. of cases requiring removal of the sac are in the working classes,

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[12] Brit. Med. Jour., Feb. 23, 1907.

[13] Klin. Monatsb. f. Augenheilk, xli, 134.

and that in nearly 35 per cent. of cases of dacryocystitis permanent dense opacities of the cornea result.

3. If there is severe ulceration of the cornea with dacryocystitis, or even lachrymal obstruction, it is often advisable at least to incise the sac and drain it, but I do not hesitate to remove such sacs, even during the height of the inflammation, since ulcus serpens must be treated vigorously to prevent perforation and loss of the eye.

4. As a preliminary to operations requiring the opening of the eyeball where dacryocystitis is present. If the fellow-eye has been lost by postoperative infection, the necessity of such preliminary operation is imperative. If an immediate iridectomy is necessary for glaucoma, or if for any reason sufficient time is not allowed for healing of the wound before opening the eyeball, it is best, anyhow, to remove the sac completely. Sutures passed around the canaliculi or cauterization of them are poor substitutes for removal of the sac, which should at least be opened and drained if the patient will not permit removal.

5. In cases of chronic lachrymal obstruction without any apparent blennorrhea of the sac when normal drainage can not be restored, as in many cases of traumatic destruction of the lachrymal channels. In such cases it is safer for the eye to remove the sac, destroying completely the lumen of the remaining connecting channels, especially since it is impossible to know how soon an acute or chronic blennorrhea may replace the apparently simple obstruction and innocent, but often dangerous, epiphora. Tooke[8] pointed out that the presence of dacryocystitis is often disguised by a high crest on the lachrymal bone, preventing proper pressure on the sac, and sometimes by the increased pressure forcing the contents of the sac into the nose instead of into the conjunctival sac.

6. When lacvhrymal fistula is present.

7. In cases in which there is necrosis or disease of the bony walls of the canal.

8. A dilated or atonic sac should often be removed, the embracing fibers of the orbicularis being atrophied, and especially in long-standing cases with partial destruction of the walls of the sac and duct and in which probes have been employed.

9. In certain cases of polypus or when there is much

thickening of the sac lining, sometimes indicated by a lumpy feeling after emptying the sac.

10. In debilitated or nervous persons or any who can not endure probing. de Schweinitz[14] considers it especially valuable in the insane.

11. In dangerous conditions, such as tubercle and malignant growths.

The various forms of operation have been fully described by Axenfeld,[13] Holmes,[9] de Schweinitz,[14] Tooke,[8] Evans,[12] Jocqs,[15] Arnold Knapp,[16] Parsons,[6] Lesshaft,[17] Kuhnt,[18] Syndacker,[19] and others. I prefer the subperiosteal method for removal of the sac as described by Axenfeld,[13] Snydacker[19] and de Schweinitz.[14] Since the fundus of the sac extends above the level of the internal palpebral ligament, great care must be used to see that every portion of it is completely removed. Parsons[6] asserts that absolutely no harm results from dividing this ligament. I find it easier to make a complete dissection when it is divided, the cosmetic result being just as good if it is properly sutured. My incision, to the bone, commences at the upper border of the internal palpebral ligament and extends downward and slightly outward for about 2 cm., just a little to the nasal side of the internal bony margin of the lachrymal fossa. The knife should point toward the ear of the opposite side. The specula stretch the tissue so that a 2 cm. cut is sufficient. There is no need of having a long cut below the internal palpebral ligament. It is easy to separate the periosteum from the inner side of the lachrymal fossa. After this is done, the sac should be seized with the forceps, pulled upward and cut off low at its junction with the nasal duct. It should then be dissected from below upward, severing the upper part last. For the first few days the wound should be disturbed as little as possible in order to avoid opening it.

One of the most troublesome parts of the operation is hemorrhage, especially if the incision has been made too far internally. If the angular vein is cut it should be ligated. I have attempted partially to overcome the hemorrhage by means of two simple specula. unlike

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14. Philadelphia Hosp. Rep., 1904-05.
15. Clin. Optalmo., January, 1906.
16. Arch. of Ophth., 1903, xxxii, No. 4.
17. Klin. Monatsb., August, 1906, xliv, ii, 256.
18. Cor.-Bl. d. allg-artzl. Ver. v. Thuringer, Weimar, 1888, xvii, 635-644.
19. Chicago Med. Rec., Oct. 15, 1903.

A METHOD OF PERFORMING TENOTOMY WHICH ENABLES THE OPERATOR TO LIMIT THE EFFECT AS REQUIRED.*

FRANK C. TODD, M.D.
MINNEAPOLIS.

A complete tenotomy of an extraocular muscle effects a change of about 13 degrees. This can be varied only by following Panas' method of stretching the tendon previous to tenotomizing, as described by Dr. A. Edward Davis before this Section in 1901; this produces somewhat less effect, because the muscle, having been previously stretched, reinsertion takes place further forward on the globe. A somewhat increased effect may be produced by extreme rotation of the eye away from the muscle after tenotomizing, thereby stretching or rupturing some of the accessory attachments.

But this does not give much opportunity of regulating the effect of a tenotomy and no possibility of correcting errors of less than about 13 degrees. Furthermore, we do not know where the tendon will become reattached, consequently how much disturbance of the muscle balance not previously existing may be brought about by this effort to make correction. Therefore, complete tenotomy is always undesirable and is, indeed, unsafe when we are aiming to bring about something more than cosmetic results. The partial tenotomy (of Stevens[1]) is unsatisfactory and I have found it entirely ineffective. This we would naturally expect to be the case, for if we leave uncut any of the fibers at each side of the tendon of an extraocular muscle these uncut fibers hold the tendon in place firmly until reattachment takes place in the same location. In those cases in which some effect has been produced by such a partial tenotomy, all of the tendon must have been severed, leaving only secondary lateral insertions (the adeniculum tendinis of Merkel[2]) at the edge.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

[1] Motor Apparatus of the Eye, p. 48.

Savage[3] proposes and practices incision of one side of a tendon; but this is for the purpose of changing the plane of action of the muscle.

Because an error of less than 13 degrees can not be corrected by a tenotomy and because of the facts just mentioned regarding the so-called partial tenotomy, I have practiced the operation described below for producing a limited effect and securing just the amount desired.

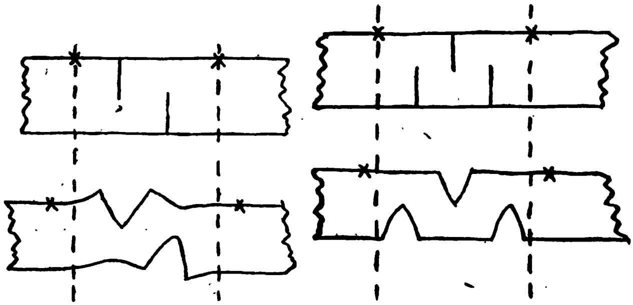

Fig. 1.—Showing the author's method of tenotomy and how it may be modified if desired.

While the severing of all but a few of the fibers of the tendon will produce no effect we may sever a portion of the tendon on one side and in another place on the opposite side, situated a short distance longitudinally from the first incision, sever the remaining fibers and thereby lengthen the tendon. However, no lengthening will take place until every fiber is severed in one place or another.

Figure 1 describes better than words how this method may be practiced and shows the results secured; it also shows how the operation may be modified and the effect increased by adding one more incision, thus placing two incisions on one side of the tendon and one on the opposite side situated between them. Besides being more complicated, this is unnecessary, for, in doing the simpler operation, we only need to lengthen the cut to produce more effect.

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[2] Howe: The Muscles of the Eye, I, p. 38.

[3] Ophthalmic Myology, p. 160.

The method shown on the left in Figure 1 is the one I have practiced in the illustrative cases herewith reported.

Case 1.—*Hyperphoria.*—C. P., male, aged 48, consulted me March 5, 1904. Test, homatropin,

R., 6/30, 6/6 + 1.25 $\overset{\frown}{\smile}$ + .50X 90 R. H. 2°, Superduct 4°.
L., 6/30, 6/6 + 1.75 $\overset{\frown}{\smile}$ + .25X180 Subduct 2°.

No cyclophoria; at times he had about a degree of esophoria. Patient having been under observation and wearing various corrections, including partial and total correction with prisms, with nothing more than temporary relief, after consultation with Dr. Würdemann it was decided to operate on the right superior rectus. A further study of the case demonstrated that there was a total R. H. of 3¾°.

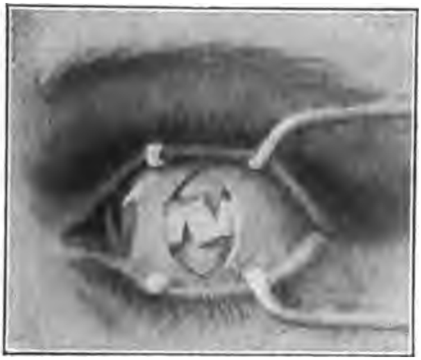

Fig. 2.—Incision in conjunctiva shown large for purposes of demonstration.

VERSIONS AS SHOWN BY THE TROPOMETER.

	Super.	Sub.	Ad.	Ab.
R.	45°	40°	50°	45°
L.	35°	40°	50°	45°

Operation.—After making a small conjunctival incision, incisions were made from each side of the tendon of the superior rectus of the right eye, one on the external side near the insertion and the other on the inner side about two-thirds the width of the tendon from the first. Following the first cutting, measurements were made with the single prism and red glass test, which showed no correction; the patient was again put on the table and the length of the incisions increased, bringing about the correction of 1.5° as shown by the prism test; a third lengthening of the incision resulted in 2° more. Desiring to secure an over-correction, a fourth incision was made correcting 1° more, thus giving about 1° of over-correction. The conjunctiva was brought together with a vertical suture and the eye covered with a pad.

Postoperative History.—First day, no diplopia; 0.5° over-correction.

Second day, 2° over-correction; pad was removed and left off.

Third, fourth, fifth and sixth days, from 2° to 2.5° over-correction shown.

Twelve days after operation orthophoria, superduct, 3.5°; subduct, 3.5°.

Test one month later showed orthophoria, superduct, 4°; subduct, 3.5°.

Six months later examination showed orthophoria, superduct, 2.5°; subduct, 2.5°; no cyclophoria, no exophoria, no esophoria.

CASE 2.—*Exophoria.*—Mrs. E. K., aged 33, brought a letter from Dr. Taylor, Huron, S. D., stating that on repeated tests she had manifested 14° of exophoria. Dr. Taylor had worked with the case some years and had concluded that an operation was necessary.

My test showed refraction under homatropin as follows:

R., 6/9, 6/5 + .50 ⊃ + .25X 30.

L., 6/9, 6/5 + .50 ⊃ + .25X180.

Exophoria at 6 m. 12°; at 30 cm. 11°; ab. 15°, ad. 28°; no hyperphoria, no cyclophoria.

VERSIONS AS SHOWN BY THE TROPOMETER

	Super.	Sub.	Ad.	Ab.
R.	30°	45°	40°	50°
L.	30°	45°	50°	50°

Treatment.—Operation was done as above on right external rectus. First incisions had no effect; the next incision, extending considerably further, brought about orthophoria. Desiring to secure considerable over-correction, a third incision was made and brought about 7° esophoria.

Postoperative History.—First day examination, no diplopia, esophoria, 4°; second day, esophoria, 9°; third day, esophoria, 7°; sixth day, esophoria, 7°; eighth day, esophoria, 3°.

Five months later measurements made by Dr. Taylor showed exophoria at 6 m. 0.5°.

A study of this operation and the cases reported bring out the following facts:

1. This method may be practiced in cases of heterophoria; the muscle balance measured by the Maddox rod or the prism test at any stage of the operation and the effect increased a little at a time (as low as one-half degree if desired) until the proper effect is secured.

2. In those cases of strabismus in which it is impossible to secure single binocular vision, measurements may be made by the parallax test (of Duane) or by the cover test and the effect regulated at will.

3. This operation may be performed in conjunction with advancement operation on the opposite tendon.

4. The possibility of the wrong insertion of the muscle is prevented, as the insertion is not interfered with, the muscle simply being lengthened.

5. The operation may be painlessly done under local anesthesia and the eye left unbandaged.

THE TREATMENT OF STRABISMUS IN YOUNG CHILDREN.*

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Ever since Donders taught us the intimate relation between convergence and accommodation we have known that the rational cure of squint is an early correction of the error of refraction; but, owing to the difficulty of accurately correcting errors of refraction in young children, we have usually waited until the child was old enough to assist us by reading the test type. Then it is too late to cure the majority of cases, and we are obliged to resort to an operation, which has yielded fairly satisfactory results from a cosmetic point of view, but unfortunately it does not restore binocular vision, and in many cases the permanent results of the operations have been far from ideal, many cases ltaer in life developing a divergent strabismus—a deformity greater than the original one. Indeed, it has come to pass, as Browne has well said:[1]

> We are all the inheritors of two legacies which unequally profit us, and though in our reasonning we aspire to be followers of Donders, it must be admitted that in our practice, we, from old custom, from want of knowledge and patience, and from convenience, do revert to the primitive view of the school of Diffenbach. We resemble those barbarians, who, converted to Christianity, prefer the orthodox theology and ethics, but who, under slight temptation, cast off their new religion and go Fantee.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

[1] Squint Occurring in Children," Bailliere, Tindall and Cox, London, 1904.

As almost every child is hyperopic, therefore almost everyone is potentially capable of acquiring convergent squint. There must be some exciting cause which in a few cases is quite apparent, such as paralysis, opacities of the cornea or lens, central chorioiditis, optic-nerve atrophy, etc. I have now under observation a bright 9-year-old boy, brought to me three years ago with a convergent monocular squint. In the squinting eye there is a small posterior polar cataract. The mother can not understand why spectacles do not correct the deformity in her child's eyes as it does in the eyes of her neighbor's children; but it is questionable whether even a tenotomy would improve the condition, and the cataract is so small that it would scarcely seem advisable to extract it. While such cases are always interesting and often baffle our best endeavors to remedy, yet it is not the management of such cases that I had in mind in the preparation of this paper. I intend, rather, to limit myself to a consideration of the ordinary concomitant squint in which both eyes are, excepting for the error of refraction, apparently healthy so far as we can determine ophthalmoscopically or otherwise. In many of these cases we have accepted the statement of the mother that the strabismus followed some slight illness, such as measles or whooping cough, or the eye was inflamed or injured, and a bandage applied, and when it was removed the eyes were crossed. Or it may be the child simply imitated another. It does seem sometimes, as Worth teaches, that there must be some congenital deficiency of the fusion sense and that a temporary suspension of binocular vision is sufficient to destroy it altogether. And to a certain extent these observations are correct, but any one who has observed the development of squint in a considerable number of young children must have noticed that squint is not developed so suddenly as we are sometimes led to believe, but that it comes on slowly. Many times the parents bring their children to the consulting room in doubt whether the child squints or not, and sometimes I have to keep the child under observation for a considerable period before a diagnosis can be made. If you have the opportunity of following a case closely it will be noted that at first the child squints only occasionally. And I believe that a more careful observation of the clinical history of these cases will show that there is first a period of occasional squinting, often lasting for weeks or months, and in a few cases for years; then a period of alternating squint lasting a greater or less period, finally terminating in a permanent monocular squint with deterioration of vision in the squinting eye.

Any one who has been long in ophthalmic practice can not doubt that there are many cases of spontaneous cure of squint, because patients later in life, when being tested for errors of refraction, pension, railroad or marine service, are so frequently found amblyopic in one eye, and volunteer the information that they squinted in early life. The persistence of the amblyopia in these spontaneous cases of recovery would suggest that the amblyopia was congenital and not ex anopsia. And yet the longer I watch these cases the more I am impressed that much of the failure in vision is the result of suppression of vision in the squinting eye and may be restored by use.

I have now under observation a man of 28 years of age with monocular squint who lost the seeing eye last September from an injury. He could only count fingers at three feet. He now sees 20/200, and the vision is still steadily improving. Another squinting patient, 34 years of age, in the same ward on the same day, lost the vision of the seeing eye from an injury. At first I could not decide whether he had light perception or not, but his vision has improved to counting fingers at six feet and he now gets around the hospital alone. I believe his vision in the squinting eye would improve faster if it were not that he still has some light perception in the injured eye.

The age at which squint first appears has a most important bearing on the treatment. Worth[2] presents some interesting statistics of 1,017 cases of monocular squint; it appeared, beginning in each each year of life, as follows:

Before one year	**134 cases.**
Between one and two years	**186 cases.**
Between two and three years	**247 cases.**
Between three and four years	**189 cases.**
Between four and five years	**113 cases.**
Between five and six years	**73 cases.**
After six years	**75 cases.**

It will be seen that nearly 75 per cent. developed before the fourth year. In 178 alternating cases more than 53 per cent. were noted before the end of the second year; thus it will be seen that if treatment is to begin, as I believe it should, with the first appearance of the squint, we must commence very early in life. Formerly I thought two years was as early as we could hope to profitably fit spectacles to children, but in recent years I have in a number of cases given spectacles to children between 1 and 1½ years of age, and in a few instances under 1 year, and the results in these very young children have been so satisfactory that I shall not hesitate to use them more frequently in the future. I have had occasion many times to assure patients and general practitioners, who have questioned the wisdom of prescribing spectacles to children so young, that any child old enough to squint was old enough to wear spectacles.

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[2] Squint, London, 1903.

As observed above, the development of squint in young children is at first occasional only; then it becomes alternating and later monocular. The propitious time to treat these cases is during its first appearance, when it is only at times that the eye is noticed to converge, either when looking at close objects or when tired, sleepy or embarrassed. Often the use of atropin for a few days in both eyes will effect a cure. If it does not, the child's eye must be carefully tested for errors of refraction and spectacles prescribed at once, which will most assuredly correct the tendency to squint. If the child declines to wear the spectacles prescribed, it is evident the lenses are wrong or the frame is not carefully adjusted.

If the case has gone on to the second stage, and there is a more or less constant alternating squint, almost equally good results will be attained if the error of refraction is corrected. If the squint persists after the spectacles are ordered, it may be necessary to use atropin in both eyes for a few weeks. There are a few cases in which the squint under the use of atropin will be increased for a time; doubtless the child makes increased effort of accommodation in order to overcome the blurred vision, but a continued use of the atropin will overcome this increased convergence.

In older children who have a persistent alternating squint, we will be obliged to resort to efforts to train the fusion sense, and this may demand great patience on the part of the surgeon. The stereoscope and the amblyoscope will aid us much. The temporary use of prisms or decentered lenses will help a little. The long-continued use of atropin and avoidance of all close work for the eyes will be of great service. These children must be taken out of the kindergarten; driving and playing out of doors will be of much service. If after months and years of trial there is no improvement, an operation to partially correct the convergence may be necessary. In a few of these cases I have failed to secure binocular vision, but a fairly good cosmetic result has been obtained in almost all of them.

Unfortunately many of the cases that come to the ophthalmic surgeon for relief have already passed on into the third stage of persistent monocular squint, with more or less amblyopia of the squinting eye. These cases will demand our best endeavors, and not infrequently baffle our efforts to restore binocular vision. Occasionally, however, we will be rewarded, even in apparently hopeless cases, so an effort should be made in every case to restore binocular vision. My notes show many cases of persistent monocular squint of many years' duration in which I have succeeded in restoring binocular vision and thus securing a perfect result.

In every case the most careful and painstaking correction of the error of refraction must be made. I have, as the years go by, become more and more convinced of the necessity of fully correcting the error of refraction. If the patient rejects the full correction, use atropin in both eyes until he will accept; then use the atropin in the fixing eye until you are convinced that no improvement can be hoped for in the vision of the squinting eye; how long this should be must be left to the judgment of the ophthalmologist; it may be weeks, it may be months, it may be years. Of course, the use of the atropin should be discontinued from time to time to see what the effect will be. The occlusion bandage should be given a trial in all cases, but in my experience it often proves unsatisfactory. In hopeful cases the vision will improve and this eye become the fixing eye, and thus the case will change from a monocular to an alternating squint, and should then be treated accordingly.

It is not my purpose to enter into a discussion of the operative treatment of these cases, except to say that I do not often find it necessary to operate on children under 10 years of age. Generally speaking, I prefer an advancement to a tenotomy, or a combination of both, but when I find it necessary to operate on younger patients I prefer a tenotomy, only attempting to correct a part of the deformity. I never perform an operation on a patient in whom the squint disappears when the spectacles are worn and returns when they are left off.

I believe the only practicable way to correct the errors of refraction in young children is by retinoscopy, and that it is utterly impossible for any one to successfully treat these cases who is not an expert in the use of the shadow test. I endeavor to use the ophthalmometer in all cases, but must confess that it has proved of little service in these young children.

It was my intention in preparing this paper to report a number of illustrative cases, but, on more mature consideration, I thought I could attain my object just as well by stating as briefly and concisely as possible my own method of treating these cases in private practice. For twenty years I have followed the methods here outlined, and it has been in exceptional cases only that I have been obliged to resort to an operation. In almost all cases when seen early I have secured binocular vision and almost perfect orthophoria, or at least with no more heterophoria than in a like number of non-squinting children. In older children—that is, those over 5 or 6 years of age—I have not been as successful, but even in these children I have succeeded in correcting the deformity in the majority of cases, and in a fairly large percentage have succeeded in restoring binocular vision.

I wish to urge those of you who do not treat your patients in this way to give the method a thorough and conscientious trial, and I am sure you will come to look on the operative treatment of strabismus as an evil necessary to be practiced only as a last resort. In my practice I look on the operation as a confession of defeat, and when obliged to make a tenotomy I have much the same sensation as when I have to enucleate an eye after having successfully removed a foreign body.

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OCULAR ROTATIONS IN PARESIS.*

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At the last meeting of the Section on Ophthalmology of the American Medical Association, held in Boston, our honored chairman in his address on the work of the Section, when speaking of the ocular muscles, stated: "One . . . who has spent much time in investigation and has written largely in expression of his views recently said at the close of a most interesting address, 'I feel as if I were only on the threshold of this study'," and also quoted another ophthalmologist as saying: "Ophthalmology is finished, you will find nothing new in it." These two quotations from this excellent address are certainly reasonable cause for further thought on the ocular rotations, and perhaps we may find that the last word has not been said on this interesting subject. Carl Weiland may well ask: "Are our present ideas about the mechanism of the eye movements correct?" Furthermore, since the discussion of the paper by our present chairman, Dr. G. E. Savage,[1] on "Some Axioms Concerning Ocular Rotations," I have felt much interested in the subject of the rotations of the eye as it moved about in the field of version; the action of the ocular muscles in causing these rotations, their points of action and the phenomena presented by their pathologic condition—paresis. A careful study of the various writings on this subject has not rendered the matter at all clear to me, even though our chairman has stated that his conclusions are axioms.

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[1] THE JOURNAL A. M. A., Aug. 4, 1906.

To present one's individual opinions on this subject in a clear and concise manner is difficult, and to demonstrate any theory is more so, especially when we find so many diversified writings on the ocular rotations and the diagnosis of paresis. I may state that this paper will refer to eyes that have normal rotation about the center. It will deal with the subjects of increased or diminished rotation as found in that anatomic condition causing heterophoria and that pathologic condition causing paresis, with the phenomena pertaining thereto.

I wish to lay special stress on the term paresis in this paper. In complete paralysis of an eye muscle it does not seem to me that there can be any question as to the diagnosis, but in paresis the subject, according to the schemes of the writers of all our text-books, seems to be extremely complicated. I understand that neurologists make a clear distinction between these two terms, and, according to my views, the distinction between paralysis and paresis of the ocular muscles should be clear and well defined.

In paralysis we have "the suspension or abolition of a functional power, especially in the nervous system, in which case there is a temporary or permanent loss of power of motion," etc. (Foster), while in paresis we have "an incomplete paralysis, especially when not associated with any demonstrable organic change" (Foster). Furthermore, I do not think that paresis should be classed under the conditions of heterophoria. I would consider heterophoria as an inability of the oscular muscles to perform a certain function. It is due to certain conditions, anatomic rather than pathologic, in which the muscle fails to act to its normal extent in the field of version. Hence I would call your attention to the last two terms, as they apply with particular force in a study of the rotations of the eyes. In paralysis the function of an ocular muscle is completely lost and the visual line must rotate or deviate in the direction of the muscles antagonistic and remain in that position. An exception to this is found in ophthalmoplegia externa, in which motion is completely lost in all directions and the eye remains fixed. In paresis the function of the ocular muscle is but partly destroyed and the visual line fails to turn in the direction of the paretic muscle beyond the median line of the orbit with a consequent diplopia. In heterophoria, with normal acuity of vision, we do not have diplopia when the look is in infinity. I state this again for the reason that it has been said that a diagnosis of paresis is made when the eyes are directed to the upper part of the field of version, with the visual line directed strongly to the right or left. It is also stated that in one of these positions the superior rectus acts as an elevator of only one eye, while the inferior oblique of the fellow eye raises the visual line (Duane, in Posey and Spiller). I can not agree with this proposition, as paresis of the inferior oblique, if it does occur, must cause diplopia with decided tipping of the image toward the side of the paretic muscle.

The most essential point to establish is the position of the eyes when at rest, with the look in infinity, in which the ocular muscles are in a state of normal tonicity. This position of the eyes is now well defined by all ophthalmologists as the first or primary position and one from which the eyes may be moved by the normal function of the ocular muscles to any secondary position in the field of version. Now, in this study of the ocular rotations and the primary position it must be understood that the position of infinity is not at twenty feet, but is any point in space, as a star. I wish to make this distinction, as practically we do have a certain amount of convergence as twenty feet, the usual distance for testing the vision. Furthermore, another essential is the visual acuity which must be at its best. In other words, in testing the eyes for the ocular rotations the visual acuity must not be reduced by any artificial means. Visual acuity reduced by mechanical means may be permissible at times, but it is not essential.

Bearing these two points in mind, we are now prepared to consider the rotations of the eyes, not from the standpoint of the rotations of a rubber ball or other artificial apparatus, but simply from an anatomic and a clinical point of view.

It seems to me like "carrying coals to Newcastle" to come before this association of ophthalmologists and speak of the anatomy of the orbits, but I wish to make some suggestions for your consideration in reference to the points of action of the ocular muscles as given in the latest publications on this subject. We find in the text-books that the origins of the ocular muscles, except that of the inferior oblique, are at the optic foramen, at the posterior part of the orbit, and that the muscles are inserted into the sclera at their respective points of attachment. All this is true, but are these points of origin and insertion also their points of action? This seems to me an important question and on its correct interpretation will depend our ideas of the mode of action of the ocular muscles. It is conceded that the origin of each of the four straight muscles is at the optic foramen, but let us trace the course of one of these muscles to its insertion. For illustration I shall refer to the superior rectus. This muscle and the other recti occupy almost the entire apex of the orbit, but quickly separating from the others the superior rectus passes upward toward the upper part of the orbit just beneath the palpebræ superioris and, surrounded by its sheath, it soon becomes tendinous. This sheath is formed of fibrous, inelastic tissue, from which strong expansions of the same inelastic tissue pass off laterally and in all directions to the bones of the orbit and to the lids and conjunctiva (Dwight in Norris and Oliver's System). The external portions of these expansions form the external palpebral ligaments. As the superior rectus reaches the back part of the eyeball it becomes tendinous and, entering Tenon's capsule, passes to its insertion into the sclera, 7 mm. from the upper edge of the cornea. From this we may note that a section of the orbit made 5 mm. behind the globe of the eye will present the appearance as shown in Figure 1.

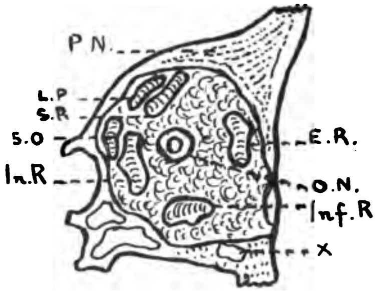

Fig. 1.—Frozen section of orbit 5 mm. behind globe. (From Norris & Oliver's system.) L. P., levator palpebræ superiosis; S. R., rectus superior; S. O., obliquus superior; In. R., rectus internus; E. R., rectus externus; O. N., optic nerve; Inf. R., rectus inferior; F. N., frontal nerve.

The orbit being filled with fat, connective tissue and the expansions from the sheaths of the muscles and

Tenon's capsule, it seems to me that the muscle and tendon of the superior rectus can have little, if any, lateral movement when the muscle contracts or when the visual line is rotated inward. The diagram (Fig. 1) taken from frozen sections shows that the superior rectus, while it can move its insertion backward or forward, moves the central part of the muscle but very slightly in a lateral direction as it is held in its position by the sheath which is attached to the walls of the orbit by these expansions of inelastic fibrous tissue. If this idea of the anatomy of the orbit is correct, and I see no reason why it should not be, then one of the points of action of the superior rectus and the other straight muscles of the eye, can not be the fibrous ring that surrounds the optic foramen, but must be at the point of the sheath just behind the globe, as shown in the section. Now when the eyeball is strongly adducted, or, in other words, turned to the limits of the inner part of the field of version, the tendon of the superior rectus will pass through its sheath at the back part of the globe almost like a pulley at right angles to its primary line of action. We have, then, these two points of action of the superior rectus: Its insertion into the sclera anteriorly and the position of the sheath at the back part of the eyeball posteriorly. In this connection it is to be noted that the same argument will apply to all the straight muscles of the orbit which take their posterior points of action from their respective sheaths about 5 mm. behind the eyeball.

It seems to me that this is a most important anatomic proposition and one that, so far as I have discovered, is not mentioned by any of the writers on the rotations of the eye in the orbits. I have been led to a study of these anatomic conditions because, I think, they have special importance in the consideration of the rotations or movements of the eye in the field of version and particularly so in the phenomena that may be presented in all paretic conditions of the eye muscles. Furthermore, I quote from one who has written extensively on this subject this statement in reference to the action of the superior rectus: "When the eye is adducted the muscle (superior rectus) will be nearly at *right angles* to the anteroposterior axis of the eye and hence will have little or no action as an elevator."[2] I would also refer to an article by Dr. D. K. Shute[3] on ocular rotations, in which is found the same statements in reference to the anatomic arrangements of the eye muscles, giving the muscle plane of the superior rectus as follows: "The lower edge of the muscle plane extends from one immovable point (the center of origin of the muscle) to another immovable point the center of rotation of the eye. But the upper edge of this muscle plane makes varying angles with the median plane, "as while the center of origin is immovable its center of insertion is very movable." Shute furthermore states: "The lower edge of this muscle plane forms a fixed angle with the median plane (27 degrees for the recti) whether the eyes be in the primary position or whether they be abducted or adducted."

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[2] Duane, in Posey and Spiller, p. 190.

This is undoubtedly true, but does the upper edge of this muscle plane always form the same angle or any other angle to the median plane? This is the important point and the sum and substance of this paper, because I am convinced that, while the points of this vertical plane of the superior rectus are as above stated, yet when the eye assumes any secondary position the upper edge of this plane then becomes completely obliterated and the essential points of the vertical plane of the superior rectus become, first, a fixed point, the center of rotation; second, a slightly movable point, situated in the sheath of the muscle a short distance behind the eyeball, and, third, a freely movable point, the insertion of the muscle into the sclera. Now, under these anatomic conditions, if my contention is correct, while the posterior portion of the muscle plane changes very slightly, the anterior portion or that portion anterior to a point in the sheath about 5 mm. behind the eyeball, changes according to the rotation, but in all positions of the look is practically in the vertical plane of the globe. I am fully aware that this assertion may deny that the superior and the inferior recti, to which the same argument applies, have only a slight tendency to tort or turn the eye on its sagittal or anteroposterior axis even when the eye is adducted thirty or forty degrees inward. In Figure 2 the conditions as interpreted by Duane and others are shown at A; at B is shown my idea of the anatomic conditions.

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[3] N. Y. Med. Jour., Aug. 18-25, 1906.

In explanation of these drawings it will be noted that in A, the two points of action of the superior rectus, we find to be the optic foramen at x and the insertion of the muscle at y′ and y², so that, when the eye is adducted 50 degrees from the primary position, the portion of the superior rectus just back of the eyeball must pass from the position a to b. If this be true, I can not understand how this lateral motion can take place, considering the extremely slight resistance the globe of the eye, resting on a cushion of fat and tissue, can possibly offer against the pull of the superior rectus when contracted. It seems to me very doubtful if such action can occur, considering that fibrous bands pass from the sheath of the muscle to the bones of the orbit and the parts surrounding it. On the other hand, looking at Figure 2, B, we find that if these fibrous bands do tend to keep the muscle sheath almost stationary in the upper part of the orbit, that is to say, so that the muscle can not move in a lateral direction at a, then the points of action of the superior rectus must be at a and y′ and y², as shown in Figure 2 B. Consequently, when the superior rectus is contracted by the stimulation of the third nerve, steadied by the tonicity of the internus and the externus and its vertical meridian always corrected by

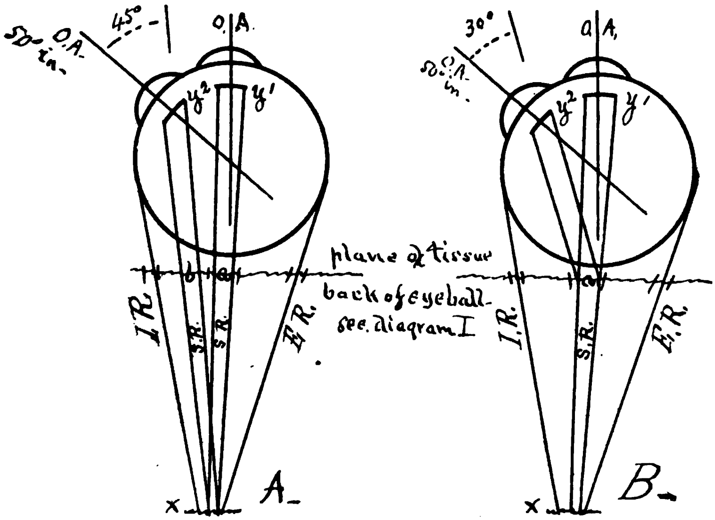

Fig. 2.—A. Action of superior rectus as interpreted by Duane and others. B. Author's idea of the action of the superior rectus.

the action of the obliques, it must act as an elevator in all parts of the lateral field of version.

Now, all this brings forward the question: Does the inferior oblique tend to turn the visual line upward; that is, does it assist or take the place of the superior rectus when the visual line is turned in any part of the field of version? We may answer that question by asking another: Is the elevating action of this muscle needed or necessary in the ocular rotation? As I have just stated, the slightest touch on the eyeball will move it from any position, and consequently the slightest action of the superior rectus will raise the visual line to any part of the field. Therefore, the supposition that the inferior oblique of the left eye is an elevator when the eyes are turned to the right, and not the superior rectus, is beyond my understanding and hence, in my opinion, the position of the images, in the upper part of the field of version, can not indicate a paresis of the inferior oblique. Thomas Dwight,[4] writing of this, says:

> Theoretically this is tolerably certain, but practically it is to be remembered that it is very unlikely that one, or even two, of these muscles ever act alone. The accuracy of any movement is due not alone to the pull of the muscle to which it is usually ascribed, but also to the graduated resistance of the antagonist. Probably the simplest movement of the eye is made by the more or less active concurrence of all the muscles.

This is probably true, but we must consider that this "active concurrence" means that, while certain muscles turn the globe, that the other muscle assists only so far as may be necessary to keep the eye steady and the vertical meridians parallel to each other in all parts of the field of rotation. Studying the question from this anatomic standpoint, we now come to the normal action of the ocular muscles in reference to the movements of the eye in certain parts of the field of version, except those of the direct vertical and horizontal rotations. As an illustration of what I consider the true physiologic action of all the ocular muscles, I would refer to the action which takes place when the eye is rotated upward and outward by the action of the superior and external recti. I can not improve on the excellent illustration[5] of this action given by Dr. G. H. Price, Nashville, Tenn., at the last session of the Association during the discussion of Dr. G. C. Savage's paper, and to this explanation I would refer the reader, as it is too extensive for insertion in this paper.

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[4] In Norris and Oliver's System, p. 98.

[5] Trans. of Section on Ophthalmology of A. M. A., 1906, 432; and THE JOURNAL A. M. A., Aug. 4, 1906.

Now, following this theory of the eye movements, it is to be noted that as the visual line goes upward its vertical meridian tends to tort inward, which action is corrected by the inferior oblique, and as it goes outward the external rectus tends to tort the vertical meridian outward; this action being corrected by the superior oblique. Now, perhaps this action takes place according to the law of Listing, which I will discuss later; that is to say, about an axis at right angles to its lines of direction. But it is by the action of the superior and the external recti alone that this movement is accomplished, and the only action of the oblique muscles is to correct any torting of the vertical meridians from the vertical plane of the orbit, and in this function these oblique muscles keep the vertical ceridians of the two eyes parallel.

In other words, the obliques do not tend to turn or to move the eyeball on its center of motion either upward or outward, but simply correct the tendency of the vertical meridians to deviate inward or outward as the contraction of the straight muscles moves the visual line in the desired direction or from point to point. I fully concur with Dr. Price in his exposition of this subject.

It is natural to suppose that the eye when changing the line of vision from one point to another will move the visual line along the shortest route, and probably it does, but this condition has not yet been fully proved, though often asserted, except for the horizontal and vertical meridians. In these two meridians we know the direction of the eye movements from the after images produced by looking at a small but intense electric light. When the eye is moved horizontally the line of after images will always be perfectly horizontal and we find the same phenomenon in the vertical meridian. When, however, the eye seeks some other position in the point of vision as in an oblique direction, it is doubtful if it does move along the shortest route. Tschering[6] says:

> The best method of studying this question (ocular rotations) would probably be to bring the look quickly from one

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[6] Physiological Optics, p 293.

point to another, leaving the eye exposed to a pretty intense light. The after images of the luminous source then assume the form of a line which permits some conclusions as to the nature of the movement.

Why Tschering did not illustrate this phenomenon in his classic work on physiologic optics I do not know. Following out his suggestion and my own previous experiments, it seems to me that when the look passes in an oblique direction, as up and out, the line of after images is not a straight line from point to point, but forms a slight curve with its concavity downward. When the look is directed from the first position to a point

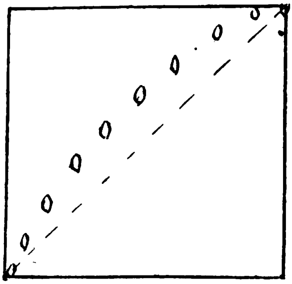

Fig. 3.—The eyes going up and to the right along the line of the diagonal of the square, the after images present the curves shown—down and to the left.

upward and to the right the line of after images is curved downward and to the left (Fig. 3). Each minute after image shows the several positions at which the eye must have made an exceedingly momentary stop. This impression of the after images was fully confirmed at the same time by Dr. E. M. Alger at the New York Postgraduate Hospital.

Now, this seems to show that the look does not always seek the shortest route when passing from point to point nor will it follow a line. It has been proved that if we draw a long curved line, and as the look follows it photograph a spot of light on the cornea, it will be found that the look does not follow the line according to its curvature, but jumps from point to point in an irregular manner until the image of the complete line has been impressed on the retina. It may be noted, therefore, that, except in a perfectly vertical and horizontal direction, when the eye movements are controlled by two or more of the straight muscles, all the lines of direction are exceedingly irregular.

These irregular movements, it seems to me, are fully and completely accounted for by the action of the straight muscles only, the function of the obliques being simply to hold or to control the vertical meridians and by this function always to keep these vertical meridians parallel to each other during these movements. In other words, I can not consent to the proposition that the obliques are endowed with two distinct functions, that of moving the eyes in the field of version and that of keeping the vertical meridians in their correct position. They have only one nerve supply and, as Flint says, "We can not, as a rule, cause only a portion of a single muscle to contract." How, then, can a muscle have two distinct functions?

As a possible exception to the above I may mention the action of the internal recti. The action of adduction of convergence being normal, there may be an evident paresis. But this action, while unique, may readily be understood from the fact that we do have two distinct central nuclei controling the action of this muscle, namely, that of adduction and that of convergence. Tschering[7] says "the muscles make possible the rotation of the globe around any axis. . . . It seems, indeed, that all six muscles are concerned each time the eye makes any motion." Very true, but, as Price has shown, the straight muscles can "make possible the rotation of the globe around any axis" and the only physiologic action of the obliques is to correct any tendency to tipping of the vertical meridians as the globe turns about any possible axis by the action of any one, two or three of the straight muscles of the eye.

It does not seem to me that these propositions can, in any way, be antagonistic to the well-known law of Listing, which says: "The eye may be brought from the primary position to any secondary position by a rotation around an axis perpendicular to the two successive directions of the visual line" (Tschering[8]). Hence a careful inspection of B (Fig. 2) will show that the obliques are not essential to any necessary rotation nor can I conceive of any possible axis around which the eye can not turn by the action of the straight muscles alone.

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[7] Physiological Optics, p. 289.

[8] Physiological Optics, p. 200.

Now, what is the normal rotation of the eyeball with reference to the movements of the visual line in the various parts of the field of version? The examination of this field should be principally objective and must be scientifically and accurately measured, not by the usual method of having the eye follow the finger or other object, as all these methods, while useful, are not strictly accurate. For this purpose I know of no instrument so useful, accurate and scientific as the tropometer of Stevens, with which we find the direct inward rotation to be 55 degrees, the outward 50 degrees, the upward 33 degrees and the downward 50 degrees. I think that we may accept this as the standard of normal rotation and any material change in these figures in our examinations must indicate some condition of heterophoria or a paresis.

In this connection it should be fully understood that in certain cases of muscular anemia these figures may be much reduced, but always showing a relative change; that is to say, a little more inward rotation than outward and somewhat more downward rotation than upward without any pathologic condition whatever.

For the objective examination of the power or equilibrium of the obliques, both in normal and in pathologic conditions, I think the clinoscope is best. It will demonstrate any tendency to declination of the vertical meridian from the normal, but I have not found these measurements of practical value in my clinical work, though they are so strongly advocated by Stevens.

Paralysis, according to the definition previously given, may be left out of this question, as it is evident that a complete paralysis of any of the ocular muscles is quickly and objectively shown in all cases. I wish to refer to the common use of this term, however, as frequently given in text-books, in which the writers refer to paralysis of a muscle when there may be only a paresis or a deficiency of rotation in certain extreme parts of the field of rotation. Furthermore, for the purpose of correct clinical diagnosis, I would draw a clear and distinct line between the terms paresis and heterophoria. Paresis is an incomplete paralysis, in which there is some pathologic condition as its primary and essential cause. This cause may exist at any point throughout the course of the nerve supply from the cerebral center to the peripheral ends of the nerve which controls the action of the muscular structure. On the other hand, in heterophoria, as I understand it, there is an abnormal functional condition of a muscle, not due to any pathologic condition of the muscle, but to an abnormal development or an abnormal insertion of the muscle into the sclera.

Now we may not study a paresis of an ocular muscle simply from a clinical standpoint in reference to any deviation from the primary position? We must then consider the various phenomena that may be presented in our patients, with a full realization that we are examining the functions of a human eye and not the possible rotation that may be shown by a rubber ball with a knitting needle axis.

Consider the eyeball as a distinct human organ, controlled by a psychologic process not fully understood, delicately poised against its cushion of fat and tissues so that the slightest disturbance of any portion of its muscular apparatus will disturb the entire economy of the organ. Consider, further, these photographs of the ocular movements when the eye follows a curved line and these after images when the eye moves its visual line in space and then we shall make our differential diagnosis of paresis and of heterophoria much more exact and complete, though we may come in opposition with Listing's law and the schemes of our text-books.

The diagnosis of paresis of the different muscles of the eyeball, according to the various methods and schemes as laid down for our study in writings and text-books, is complicated and difficult to understand. I do not think that mnemonics will help us much, as, to my mind, they seem to be arguments made and elaborated from a mechanical device and not from clinical conditions.

I feel assured from my past limited experience that in the early stages of all cases of paresis there must be a decided diplopia if the eyes are fixed in the first position; that is, when the look is in infinity. I know that this assertion has been previously advanced by other writers, notably Linnell, and I would insist on its being the first and most important point in the diagnosis of the slightest paresis of any ocular muscle. We must concede this point, as, I think, it must be the crucial test between that of a pathologic condition and that of an abnormal anatomic condition; in other words, the differential diagnosis between paresis and heterophoria. I would say, too, that when the eyes are in the primary position, with full acuity of vision, there must be paresis if diplopia is proved, while in certain abnormal conditions, as in heterophoria, diplopia is present or may be produced by certain procedures that reduce the visual acuity, but that this diplopia does not in any way indicate paresis. I would illustrate this by the diplopia in cases of heterophoria shown by the use of the red glass or even by the Maddox rod.

Certain other phenomena have a prominent place in the text-books in reference to paresis. I refer to the crossing of the images and to the tipping of one of the images in certain pareses when diplopia is present in certain parts of the field of vision. I may well ask if these phenomena, when present in a case of paresis, are worth our serious consideration. The latest testimony on this subject says that the tipping in many cases may be due to a primary declination of the vertical meridian. Consequently "the failure of uniformity (in this symptom) may militate against the correctness of the diagnosis," and "unfortunately . . . these conditions (also crossed diplopia) are not always uniform from the fact that homonymous diplopia is sometimes found with paresis of the inferior rectus and crossed diplopia with paresis of the superior oblique."[9] Fuchs states that "all paretic conditions may be complicated by heterophoria." This complication makes all schemes for the diagnosis uncertain. Swanzy, in reference to the diagnosis of paresis of the superior oblique and the inferior rectus, says: "It is only necessary to remember that in one case the images are crossed, but that the tipping of the images is the same."

In a case of paresis of the inferior rectus recently examined I found no tipping of the image of the paretic eye, yet in a case of paresis of the superior oblique I found very decided tipping. This patient was seen at my clinic at the New York Post Graduate Hospital, and at the examination the images of the candle were slightly crossed with decided tipping of the image of the paretic eye. This was shown with the upper end of the candle leaning inward toward the median line, which, according to the laws of projection, shows a rotation of the upper part of the vertical meridian outward. The superior oblique is the only muscle that controls this function and the diagnosis was confirmed.

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[9] Text-book of Ophthalmology, p. 462.

I shall not dwell on the diagnosis of paresis of the internus, nor that of the externus, as in a paretic affection of these muscles the diagnosis is comparatively easy by the usual subjective and objective tests. This is particularly so when the tropometer is used to confirm the subjective symptoms. I would state, however, that I have never noticed the tipping of one of the images so frequently referred to in the text-books.

We have remaining the elevators and depressors of the eye or the superior and the inferior recti, and the diagnosis of paresis of these muscles, according to the formulas or schemes usually given, is difficult and it is hard to determine just which muscle is affected. Yet to me it does not seem that it should be so nor that the diagnosis should be so complicated if we leave out of the question the tipping and the crossing of the images.

Take, for instance, the diagnosis of a paresis of the inferior rectus from a study of the schemes of the text-books in paresis of this muscle and that of the superior oblique. Starting from the first or primary position, we have diplopia in both conditions, but in the case of a paresis of the oblique there is also a decided tipping of the image. In paresis of the inferior rectus, Mauther and others state that we also have tipping of the image toward the temple; but does it tip in paresis of the inferior? Only lately I examined a case of paresis of the inferior rectus, and at no position, near the region of the primary position, was there any tipping of the image of the paretic eye. I know that one case does not prove a condition, but if we do have this tipping of the image must we not eliminate any cyclophoria as a complication? My experience has shown that the examination of the field of version with the tropometer will at once locate the paretic muscle.

Granting the above, it seems to me that we can consider a paresis of the obliques in a few words. It is almost universally conceded that the essential action of the obliques is to keep the vertical meridian of each eye parallel to the median plane of the body, or, in other words, one vertical meridian parallel to the other. Consequently the slightest pathologic condition, at any part of their nerve supply, must result in a loss of this verticality of one of the meridians with consequent tipping of one of the images. Now this may be associated with some slight horizontal diplopia due to the disturbance of the entire ocular apparatus from the impairment of so important a function by the paresis. Whether the diplopia is homonymous or heteronymous makes little difference, as I think that this will depend simply on some pre-existing heterophoria and consequently is not essential to a correct diagnosis.

The nerve supply of the superior oblique comes from the fourth nerve or patheticus, while that of the inferior oblique comes from a branch of the third nerve or motor oculi. Hence we can readily appreciate that a paresis of the superior oblique will be much more frequent than that of the inferior oblique and clinical statistics prove this. In my experience, considering this contention as to the diagnosis, I doubt some of the reports of a paresis of the inferior oblique. I have never seen such a case; why, I do not know, as even in paresis of all the other branches of the third nerve I have not noticed any special tipping of the image of a candle.

Considering the unique action of the obliques, and apart from any action they may have in moving the visual line in the field of version, the diagnosis of a paresis becomes comparatively easy. In such a case as paresis of the superior oblique, even if it be complicated with positive declination (Stevens) there may possibly be a slight vertical or crossed diplopia. But there is a very decided tipping of the image of the candle when this is used as a test of the diplopia; one image will appear vertical and the other leaning or tipped toward the median line of the head. We then rapidly decide to which eye the candle that leans belongs and we have only to remember the laws of projection for the indications of the muscle affected.

Suppose there is a paresis of the right superior oblique, then the vertical meridian of that eye must lean outward from the action of the inferior oblique, and as the rays from the upper end of the candle will fall on the lower and outer part of the retinal field they will be projected upward and inward so that, to the patient, it will appear to lean to the left. This is a subjective test, but it can be fully and objectively verified by the examination of the declination of the vertical meridian with the clinoscope of Stevens. All this will apply to a paresis of the inferior oblique, but this condition is too infrequent to require a detailed description. Linnell says: "If the left eye sees the leaning candle and the inclination is toward the right, the affected muscle is the superior oblique of that eye. If it leans toward the left, the affected muscle is the inferior oblique of that eye."

If we accept the foregoing method of diagnosis we may leave out of consideration the action of the obliques in paresis of the straight muscles, except so far as that the paresis of any eye muscle may disturb the harmonious action of all the muscles.

SUMMARY.

All tests for paresis must be made with the look in complete infinity and with full acuity of vision.

We must have a standard of the field of version for comparison of any deficiency of rotation.

The straight muscles are capable of moving the eyes in any part of the field of vision and from one part of the field to another; in other words, in no part of the field will the straight muscles fail to act according to their usual function.

The obliques take no part or action in the rotation of the eyes in the field of version; in other words, the oblique muscles do not elevate or depress the visual line.

A distinct line must be drawn between paresis and heterophoria as shown by the diplopia; in the first by diplopia in infinity and in the second by the possible diplopia with reduced vision.

In the consideration and diagnosis of paresis we may exclude the condition of crossed or homonymous images and also the tipping, except in a pathologic condition of the obliques.

The individual muscles of the eyes are not endowed with two distinct functions, as they have but one nerve supply, except possibly in the action of convergence and inward rotation due to two distinct nerve centers.

The points of action of the straight muscles of the eyes are the insertions and the sheaths of the tendons as they are situated in the orbit just behind the globe.

CONCLUSIONS.

I feel that these conclusions are correct and offer them as my personal experience in the field of ocular rotations and paresis, because in this manner they have impressed me during my clinical work. As they are so much at variance with the usual teachings of the textbooks and of the writers on ocular paresis, I trust that they will meet with an open discussion. If I have written a word that will make the subject more clearly understood I shall at least feel that this paper and this work have not been in vain.

I close this paper with these words of Gasser: "In the physical architecture of the eye alone is written large that Nature is an idea; a constructive, creative development; an evolution of which we are a related part."

OCULAR NEURASTHENIA.*

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For several years I have been greatly interested in studying the relations of remote nervous conditions to eye work or ocular disease. My attention was, I believe, first centered on the subject by a number of cases of chorioiditis in young persons where syphilis, rheumatism and tuberculosis were excluded..[1] Other physical troubles were present, which I have since come to believe causes of uveal inflammation.

Five years ago a young girl who suffered from asthenopia, which I could not relieve, and who had certain accommodative symptoms which one would unhesitatingly attribute to hysteria, developed a small area of exudative chorioiditis. In short, there had apparently been a series of symptoms of an "irritative" type, if I may use the term, ending in objective inflammation. This child recovered from the chorioiditis, but certain intestinal derangements persisted; and with them an inability to do much eye work. Of course the latter was put to the credit of the former chorioiditis. Two years ago these abdominal symptoms took on a close enough resemblance to appendicitis to justify exploratory incision. Chronic appendicitis was found, an adherent appendix removed, and for two years there has been no complaint of eye fatigue. The total refraction error is H., 0. 75; all latent. Yet, during the stage which I have termed "irritative," the manifest error was oblique astigmatism, sometimes minus, again plus, while the near-point and far-point of accommodation approached each other, and the range of A. was reduced to two D. or less. Convex lenses restored normal near-point, concave normal far-point. Neither gave relief. Tests under mydriasis from atropin or hyoscyamin gave variable results and yielded only the transient therapeutic benefit, common from enforced rest.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

[1] Proc. A. M. A., 1896.

Were those annoying eye symptoms hysterical, or were they, as indicated by disappearance after abdominal operation, due to this remote condition? If the latter, then a field of investigation is opened in a puzzling class of patients, and if we are physicians as well as oculists we must enter it. It is, then, from the standpoint of remote causes that I want to discuss certain stubborn eye symptoms. I have defined the patients as ocular neurasthenics, using the word neurasthenia in its derivative sense—weak nerves—and regarding the ocular state as one of extreme susceptibility to outside irritation. The nature of the irritation I do not pretend to define; whether reflex, and limited to nerve action, or through the vascular system. The word "irritation" itself is unsatisfactory, but I know of none better.

What, in general, are the ocular symptoms these cases present? Chiefly, early fatigue in eye work. When search is made for ocular cause, sometimes refraction error is found, and then, with fatigue, there may be symptoms characteristic of this error. For instance, astigmatism is associated with frontal headache; but cylindrical glasses do not increase working ability. Hypermetropia is attended with fading of print, but no help is obtained from correction. Muscular imbalance may, with fatigue, present ocular tension pains. But the muscular imbalance itself varies, and prisms, either worn or used for exercise, are worse than useless. What the patient seeks is increased working ability. He will willingly put up with the pain, and as a matter of fact does so, for these unfortunates do not belong to the indolent classes. Business men, school teachers, students, boys and girls who are bright and want to work, persons with responsibilities and full willingness to meet them, are the ones who come for relief. After repeated failure by optical correction, one is tempted to diagnose hysteria. Yet there are no such symptoms as crises, stigmata, anesthesias, etc. Nor is there amblyopia, contraction of fields or reversal of colors. The only ocular symptom I have noted which can be called typical of hysteria, is in the accommodation. The approach of the near and far points to each other, especially shortening of the far point is seen; yet, as in the case related, subsequent history takes from this an hysterical explanation.

If we are satisfied with this diagnosis, simply because correction of refraction error, muscular or accommodative abnormality fails to relieve, we not only show our own lack of thoroughness, but our patient is in a worse plight than before: for every therapeutic failure increases subjective tendencies. We are dealing with a class of patients who are either inherently neurasthenic or are made so by some temporarily exciting cause. For some reason the eye, in its functional activity, is the receiving end of the neurasthenic tendency. Successful therapeusis must take into consideration four factors: 1, the mental state of the neurasthenic; 2, remote physiologic lesions, psychical, emotional, social and industrial environments which can produce neurasthenia; 3, such lesions, physiologic functions and environments which experience shows can cause ocular lesion or affect ocular function; and, 4, the ocular conditions which can give neurasthenia an eyeward tendency.

THE NEURASTHENIC MENTAL STATE.

In dealing with it from the oculists' standpoint, it has seemed to me that, possibly without knowing it, the neurasthenic conceals the very thing we want. No matter how frank he or she may seem, regardless of the fulness or volubility of description, there is always something held back.

My friend, Dr. L. F. Barker, of the Johns Hopkins Hospital, has published[2] an interesting and instructive paper on "The Psychic Treatment of Some of the Functional Neuroses." He lays stress on what he terms "avowal." By it he means getting the patient willing to tell everything. Until we have accomplished this nothing can be done. Two or three examples will illustrate.

A boy at college could work only a few minutes, and correction of refraction error did not help. He attributed his troubles to a kick on the forehead in a hazing spree during his freshman year. After two years of worry on my part I sought his university advisor and found a few old conditions hanging over the youngster, and his senior work handicapped by fear that he would not graduate. I told him, when he proposed a week's rest in the country, to tackle those old conditions and get them out of the way. His mortification at my knowing this and abuse of the man he thought had told me—the wrong man, by the way—were wonderful; but he did it, and got well.

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[2] Internat. Clin., Philadelphia, January, 1907.

For eight years I tried to keep up with the vagaries of astigmatism and accommodation in a lady of social position and cultivation. She had, I thought, told me everything, until I learned from a gynecologist that she had a fibroid which she declined to have removed, but which often caused excessive hemorrhage. Her reason for not telling me and other oculists she had consulted was that she thought "it had nothing to do with the eyes."

A medical student, unable to work, with a refraction error of half diopter hyperopia, and a muscular balance, varying from orthophoria to five or six degrees of hyperphoria, accidentally admitted the antikamnia habit. He had taken the drug for relief of pain due to intestinal putrefaction; indicanuria was present.

A physician with half a dozen pairs of glasses from an equal number of oculists or opticians, all of them directed to removing accommodative strain, while his real error was a low astigmatism against the rule, was harrassed by fear of Bright's disease. Primarily, oversight of the real eye trouble and treatment of a symptom were responsible for failure to relieve. This failure produced the mental state which kept the man neurasthenic, and correction of astigmatism, without "avowal" on his part of the mental dread, would have done no good. Such cases take time and demand no little tact; often the family physician or some friend is essential. Still, if cure is our object the remote cause must be found.

PHYSICAL AND PSYCHICAL CAUSES OF GENERAL NEURASTHENIA.

For present purposes, it will suffice to consider these under the third division, viz., physiologic function, and remote lesion or constitutional disease, which we know can both cause neurasthenia, and affect the eye, functionally or organically; also, the psychic state, which shows itself in ocular function chiefly because this function has so great a share in the individual's activities.

In a not inconsiderable experience I have thought that many cases of eye fatigue, associated to a greater or less degree with symptoms of so-called hysteria, were eventually traced to the existence of syphilis, hereditary or acquired. Sometimes the fact was unknown to the patient, and there was no obvious reason to suspect it. Again, it was concealed. Ametropia, to which symptoms were attributed, was either a coincidence or at most only an exciting ocular cause. The question of importance is this: Is it possible for syphilis to keep up an ocular irritation, simulating the symptom-complex of ametropia, before objective lesion is seen, or even without producing such lesion ? Tabetic pains before ataxic symptoms, occasional hypersensibility of the pupil before tabetic rigidity, seem to point that way. A few years ago a lady of forty was treated in vain for headaches and eye fatigue by correction of refraction error and accommodative insufficiency. The rest treatment for hysteria was followed for months. She never seemed very ill and all of us thought the diagnosis of hysteria ample explanation of her condition. Finally she developed double optic neuro-retinitis and then, with attention turned toward a cause for this, history of syphilis in the husband was found. Though a medical man, he had kept this information to himself, as well as a transient dermatitis from which his wife had suffered. Indeed, he was sure the whole infection in himself had been cured and the sole manifestation in his wife he had not attributed to the correct cause.

A lady, 35, married to her second husband, presented the tension pains characteristic of heterophoria. Only hyperopic astigmatism with the rule and of low grade was found. Its correction did no good. Hysteria was again a satisfactory diagnosis to oculist and physician, till one evening at a concert she developed abducens paralysis. Then a history of syphilis, contracted in her first marriage, was obtained. The reasons for her concealing it were obvious.

I have tried in vain to relieve the fatigue symptoms of children by correcting ametropia, and later interstitial keratitis has shown why I failed. Diagnosis under such conditions may sometimes be impossible, and "hysteria" may perforce be our diagnosis till events show us the contrary, but this need not always be the case, and watchfulness for other causes of eye fatigue than coexistent ametropia will sometimes be rewarded.

A second remote condition often associated with eye fatigue is gastro-intestinal derangement. Under the terms intestinal putrefaction, autointoxication, etc., we have of late years been studying a new series of causes in eye inflammations. De Schweinitz presented the subject to this Section at Boston last year in his usual able way. He showed here, as he and others have elsewhere, that we must recognize these gastro-intestinal derangements as causes of uveal inflammation. The uveal tract, again, is active in eye function, and the question arises, can autointoxication, or whatever it is which produces inflammation, cause ocular irritation, leading to early fatigue, and bring about those accommodative phenomena which we are accustomed to call "hysterical?" The case narrated in the beginning is the only one I have met where definite uveal inflammation followed what seemed to be irritative symptoms, but I have seen numerous cases of ocular fatigue and hysterical accommodation associated with intestinal putrefaction, indicanuria, etc. Some have shown improvement in eye work after treatment directed to the intestinal condition. Another class of cases is made up of patients with symptoms leading eventually to operation for appendicitis. I have followed the surgical history of many of them and learned that the conditions found were catarrhal appendicitis, adherent appendix, etc. In these, decided improvement in eye function followed operation. It is difficult to connect ocular function with this remote irritation. The path may be that of general neurasthenia, circumstances which are unknown, making the eye specially sensitive. Whatever the explanation, the cause of ocular sensitiveness seemed to have been removed by abdominal operation. On the other hand, I have observed, as I believe all of us have, cases of eye fatigue *after extensive* abdominal or pelvic surgery. Surgeons do not hesitate to blame postoperative neuroses on adhesions; what I want to set forth, and what I think is a promising field of study, is that either through autointoxication or nerve irritation there is a close relation between abdominal lesions and eye function. Recognition of the fact is important, for many of these cases are susceptible of diagnosis and cure.

MENSTRUATION AND OCULAR NEUROSIS.

Another condition which demands attention in connection with ocular neuroses is the menstrual function. There are three points of view from which the relation of this function to the eye may be studied.

1. Uveal inflammation during the establishment of menstruation. Soelberg Wells and others called attention to this years ago, and it is sufficiently common to require no comment.
2. Exudative chorioiditis in young women with dysmenorrhea, scanty, excessive or irregular menstruation.
3. Ocular fatigue with normal menstruation.

The question of etiology between menstrual anomalies and ocular inflammation at once suggests some common cause for both troubles. What is known as "chlorosis," to which the menstrual anomaly is usually traced, means, so far as I can see, anemia, malnutrition or the intestinal manifestations of putrefaction; in a word, conditions which modern study has pointed out as causes of eye inflammation. It is of little consequence from the ocular point of view whether the menstrual derangement is primary or secondary to one of the conditions mentioned. Do irritative eye conditions, without visible inflammatory changes, occur with these remote conditions? I am sure they do; and when adequate explanation for ocular fatigue is not found in ametropia, or when fatigue persists in spite of its correction (especially if "hysterical" accommodation be present) our duty is to make judicious inquiry into the possibility of remote irritation. Failure to do so means that the patient loses confidence from our non-success, goes elsewhere, probably to have a similar experience, and gradually drops into a grave form of neurasthenia. I have seen a few cases of unexplained eye fatigue which seemed to originate in use of the eyes during menstruation, and comfort was obtained by refraining from eye work at such time.

PSYCHICAL CAUSES OF OCULAR DEFECTS.

So far I have spoken only of physical conditions found in association with fatigue and with, so-called, hysterical eye defects. They are easy of recognition, if one thinks of them, and can usually be managed. Social, industrial and kindred causes of general neurasthenia sometimes seem to expend their force on the eyes. These causes take hold of the personal life of the individual and are hard to unearth. They are, I think, more common in business men, and women who have business responsibilities, than in other classes. A single illustrative case will suffice. A man with family, bookkeeper in a large department store, at age of forty, went to an optician because he found that after a day's work he had headache. An oblique astigmatism was incorrectly neutralized by cylinders. Metamorphosia resulted. and the optician's oculist were consulted. Convex "pasters" were added to the cylinders and for several months this combination added to the pain already started by twenty years of grind over books. only twice laid aside for a week's vacation. Fear of serious eye disease practically paralyzed this man's usefulness. It would seem that such a case should be clear to anybody, but it was not. I am sure there are grades of industrial nerve exhaustion which often go unappreciated. What is ordinary work for one is overwork for another. Conditions philosophically accepted by one fill another with dread. These cases usually present in manner, mode of expression or history, something which indicates that there is other trouble than coexistent refraction or accommodative error. Only fatigue symptoms are voluntarily given, the rest must be found out. The patient often insists that the eyes must be the cause of inability to sustain eye work. Such insistance, coupled with inadequate eye explanation, should lead to search for remote cause. A few direct questions will sometimes bring out essential facts, while again an open confession on our part that there is not enough eye trouble to account for the symptoms and that patient investigation will be needed may bring us a full "avowal" at a later consultation. This state of mind in the laity is not unnatural and we are partly responsible for it. Our teaching of the importance of ametropia as a cause of almost everything in the way of a neurosis—with some truth in all the claims—has simply been carried too far by the public. It is the business of the examining optician to whom these busy men and women often go first to encourage this mental state, and they do it fully. Our business is to recognize other causes as influencing ocular function; to get the patient to regard us as eye physicians, not merely eye examiners, and make him content to leave the case with us as physicians. We should not abandon him to ignorant choice of some other specialty, which he will make as he interprets his own vague and changing symptoms. Many persons whom we term "rounders" and who literally dump on us a whole satchel full of glasses, varying within a half diopter of each other, become so by insufficient diagnosis from the first man who sees them.

There are certain objective changes in ocular structures which I believe direct a neurasthenic tendency eyewards. They exist, too, without symptoms; at least without any of which the patient takes cognizance. On the other hand, neurasthenics not only find them out, but they center nerve weakness on eye functions. Such things are follicular conjunctivitis, scaly blepharitis, chronic conjunctival hyperemia, sometimes due to nasal trouble, etc. Treatment of such a lesion is useful; but if the physical, mental, emotional or industrial causes of the neurasthenia can be found, proper therapeusis becomes possible most of the time; without such information we are treating only exciting causes.

I purposely omit the general neurasthenic who is sent us by physicians to determine the possibility of ocular origin. This class is large, and when ametropia or heterophoria exists correction is most beneficial. But these patients must have treatment directed to the general condition. Such patients as I have been trying to present may easily become neuresthenics of graver form, and the responsibility for the outcome rests on the broadness of view and thoroughness of diagnosis on the part of the oculist to whom they apply for relief in the initial stage.

Treatment of these cases means, of course, discovery of the underlying cause. Correction of refraction error and muscular imbalance, provided the latter can be definitely enough determined to justify correction, are assumed. There is one therapeutic mistake we are apt to make, namely, "coddling" such eyes by rest. Now and then, as in cases of overwork or threatened general breakdown, rest and change are essential, but as a rule the patient is encouraged and the mental attitude improved if some eye work is allowed. The personal equation must be studied. While ocular neurasthenics may work in spite of discomforts, others have not the will power to do so, or are held back by fear of injuring their eyes. I think this mental state is especially common among well-to-do persons with little real responsibility. This is just what they need; neither rest nor travel gives it.

In the paper to which allusion has been made Dr. Barker gives "persuasion" and "suggestion" as two therapeutic measures available against general neurasthenia. The former, he argues, appeals to a higher cerebral center than the latter. In "suggestion" the patient is dominated by a superior will. By "persuasion" we gain his active co-operation. A certain class of ocular neurasthenics are successfully treated by making them convince themselves of the harmlessness and insignificence of their symptoms by persuading them to work in spite of pain. Fixing the time for eye work a little short of the fatigue point and gradually increasing it, the patient learns that he can work without injury. This is the first gain, and the rest often takes care of itself.

SUMMARY.

Fatigue symptoms, unrelieved by refraction correction, and often associated with the so-called hysterical accommodation, may be due to special susceptibility of the eyes to outside irritation, either physical or psychical. These cases may be classified as ocular neurasthenics, though they seldom, at least in the stage when they come under the oculist's care, present symptoms of general neurasthenia. They occur usually among industrious people. It is easy to dismiss them with a diagnosis of hysteria, but more thorough search for cause or subsequent development reveals an underlying condition capable of producing an objective ocular lesion, but at the time producing symptoms which, for want of a better term, must be termed "irritative." Among these causes are unsuspected syphilis, intestinal disorders, hemic and nutritive troubles, pelvic anomalies and functional and psychic influences. The symptoms which should lead the examiner to look for such remote conditions are absence of ocular explanation for the symptoms or persistence of the latter, after ocular abnormalities have been corrected; "hysterical accommodation," varying refractive state. There are certain ocular troubles which usually cause little of no annoyance but which may direct a neurasthenic tendency eyeward. Relief of these somewhat lessens susceptibility, but only discovery of the underlying cause, with its medicinal or surgical treatment, cures. The aid of workers in other medical fields is often essential to correct diagnosis. Diagnosis of ocular hysteria, with its unsatisfactory treatment, is justifiable only after careful search for remote causes has given negative results.

It may not be amiss, finally, to state what seems to me adequate search for ocular cause of fatigue symptoms; in other words, to express my own idea of what constitutes thorough refraction work, and the time when the refractionist can feel that he has done all possible along that line. This seems essential because the need for search for remote causes is based on failure of ametropic correction to relieve, and there seems lack of accord in the profession as to how this work should be done.

1. The manifest refraction state should be determined by subjective tests, with range of accommodation and muscular balance. Should the latter be faulty its sthenic or asthenic quality should be determined. Comparison of this with the subjective refractive condition gives us an idea of the conditions under which the patient is working with fatigue symptoms. This comparson often affords an explanation, impossible if the two factors are studied separately.

2. Determination of objective refraction under complete cycloplegia, unless the age of the patient contraindicates the use of a mydriatic.

3. This should correspond with the objective findings, and when it does not the reason will usually be found in unaccountably incomplete cycloplegia.

4. Subjective tests after the ciliary muscle has regained its activity. Accommodative range and muscular balance are often different from the states found during the fatigue period, and are essential guides in determining what proportion of a total error should be corrected. These principles are well recognized, but I incline to the opinion that, especially in the use of a cycloplegic, and determination of accommodation and muscular balance after the ciliary muscle has regained activity, they are often neglected.

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A PROTEST AGAINST THE EMPLOYMENT OF PARAFFIN INJECTIONS NEAR THE EYES

OR THE USE OF SOLID PARAFFIN IN THE CAPSULE OF TENON AFTER ENUCLEATION, WITH REPORT OF TWO CASES OF INJURY.*

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The following cases are put on record to call attention to the fact that paraffin injections near the eye, or a solid mass of paraffin placed within the capsule of Tenon itself, after enucleation, are not without danger. Dr. F. Gregory Connell[1] well says:

> The attempts at improvement which terminate unsatisfactorily are of even more import than are the cases which result favorably. The temptation is to report the successful operations and to postpone indefinitely a report of those cases which had an unfavorable outcome, in this way giving to one searching for a verdict on the method a biased conception as to the results one may reasonably anticipate. The satisfactory results are sufficient in themselves. The failures demand further attention and investigation, both from the operator and the profession at large in an attempt to discover the cause of the fault and to place it at the door of the method or of the one who employs the method.

In the two cases reported by me, the nature of the accident in the first case is similar in character to that already reported in a number of instances; that is, escape of paraffin into the tissues of the upper lid as a result of a paraffin injection at the root of the nose. The accident in the other case, however, is unique, so far as I am able to discover from a rather careful examination of the literature on the subject. In this case, a solid ball of paraffin had been placed within Tenon's capsule after enucleation for injury of the eyeball; in other words, the Frost or modified Mules operation was performed. The result was that a solid mass of paraffin escaped from the posterior part of Tenon's capsule into the apex of the orbit, pressed on the optic nerve and caused marked sympathetic irritation in the fellow eye.

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[1] THE JOURNAL A. M. A., Sept. 19, 1903, p. 697.

Following is a detailed report of the two cases:

Case 1.—Mrs. B. W., aged 35, was sent to me June 14, 1906, by a nose and throat specialist of this city, on account of a marked ptosis of the right upper lid, which had persisted for two years.

History.—This ptosis was the result of a single injection of paraffin, melting point 100° F., at the base of the nose, to correct a saddle-backed deformity of that organ. A swelling in the right upper lid appeared immediately after the injection of paraffin into the dorsum of the nose and was followed by a marked inflammatory reaction of the right upper eyelid which kept the eye closed for six weeks. After subsidence of the active inflammation the upper lid remained drooped 3.5 to 4 millimeters, and was in that condition when the patient came under my observation.

Examination.—A flattened lump could be felt under the skin of the upper lid and the fold of skin just above the lid, extending entirely across the lid laterally from the nose to the outer canthus. Several yellowish spots, from 3 to 4 millimeters in diameter dotting this flattened tumor, could be seen through the skin of the upper lid. The skin was firmly fixed to the tumor and had become hardened, or undergone the degeneration known as keratosis. The motility of the eye was unimpaired and the vision was 20/15, with a normal fundus. The left eye and eyelid were normal in every respect, with vision 20/15. There was also a lump on the forehead just above the root of the nose, about one-half inch in diameter, which was the result of the original paraffin injection into the nose. This had remained about the same size for two years.

Treatment.—June 26, 1906, under cocain anesthesia a horizontal incision one inch long was made at the upper margin of the upper lid and a mass of connective and fibrous tissue, together with particles of the paraffin were dissected away. Around the particles of paraffin was a straw-colored fluid, and it was this fluid that gave rise to the yellowish spots seen in the tumor through the skin of the upper lid. The wound was closed with five or six silk sutures and healed by first intention. The ptosis was completely relieved and the patient was most pleased with the result.

The macroscopic appearance of the tissue was similar to that described by Dr. M. L. Heidingsfeld, as were also the microscopic findings.[2] Dr. E. L. Oatman of this city made the microscopic examination of the tissue removed. In Dr. Heidingsfeld's two cases the paraffin had been injected into the cheeks by quack doctors to beautify the patient; in one about three years and in the other about two years before coming under his observation. A complete histologic report of the nature of the tissue removed from his cases, illustrated with excellent photomicrographic plates, is given by Dr. Heidingsfeld in his interesting and instructive paper. Of his conclusions as to the changes of paraffin prosthesis I shall have occasion to speak later.

Case 2.—H. R., aged 7, was brought to me by his aunt, June 28, 1906, with the following history.

History.—One year ago his right eye was injured by a piece of percussion cap entering it. Ten days after the injury, because of symptoms somewhat resembling lockjaw, it was thought best to enucleate the eye; this was done by a New York oculist, and a solid ball of paraffin, melting point·120° F., (49° C.), was placed in the capsule of Tenon, the straight muscles sewed over it and also the capsule of Tenon and conjunctiva by means of the usual purse-string suture. A shell was placed over the stump a few weeks later and all went well until about six or eight weeks before the patient came under my care, when the artificial eye began gradually to squint inward toward the nose. After the convergence of the artificial eye, the left eye began to pain, to become reddened, and to run water; headaches also supervened after using the eye.

Examination.—When first seen by me the right, or prosthetic eye converged 35 degrees. When the shell was removed the stump was found much shrunken, but on palpation deep into the orbit with the finger a hard lump could be felt at the temporal side of the apex of the orbit, which evidently was the mass of paraffin which had escaped from the capsule of Tenon. The left eye had marked circumcorneal injection, there was decided lachrymation, and the eye was very sensitive to light, requiring a shade to be worn, and the patient complained of frontal headache.

Treatment.—On July 2, 1906, under a general anesthetic, an incision was made through the right shrunken capsule of Tenon, but not a particle of paraffin remained inside of it. The incision was then continued to the apex of the orbit to the hardened mass and a solid lump of paraffin, 20x14x8 millimeters, almond shaped, was removed with forceps, and also a small fragment of paraffin, 7x5x3 millimeters. The orbit was dressed and the patient was discharged after having been under observation one week. The very pronounced sympathetic irritation in the left eye was speedily relieved after the removal of the mass of paraffin from the apex of the orbit. The paraffin was not disorganized or disintegrated in the least, but was in solid mass without invasion of any kind of cells.

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[2] Jour. of Cut. Dis., Nov. 19, 1906, p. 513.

Accidents similar to the one which occurred in Case 1, that is, extrusion of paraffin into the tissues of the eyelids have been reported by a number of observers, and extrusion of paraffin from the sclera and the capsule of Tenon anteriorly, following Mules and Frost operations, when paraffin was used to form the artificial stump, have been reported in several instances. But extrusion of paraffin into the apex of the orbit from the capsule of Tenon, until now, has not been reported, so far as I am able to discover. In this respect, therefore, Case 2 is unique. The cause of this peculiar accident in Case 2 was due, in my opinion, to faulty technic on the part of the operator, the capsule of Tenon in all probability being punctured posteriorly and to the temporal side at the time of the operation. After a few months the solid mass of paraffin escaped through this opening into the apex of the orbit, pressed on the optic nerve and finally produced marked sympathetic irritation, which undoubtedly, had it not been removed, would have resulted in a true sympathetic inflammation of the fellow eye.

Ramsey,[3] in a report of a series of thirty-four cases (twenty-two at one time and twelve later), in which paraffin at 40° C. was injected into the capsule of Tenon after enucleation, had four failures from the paraffin extruding anteriorally. A more serious complication resulted in one case. He says:

> Once sympathetic inflammation followed enucleation and injection; but I do not think that any blame can be attached to the paraffin. The case was one of septic wound of the eyeball, in which, after enucleation, the optic nerve was found to be acutely inflamed. Strict antiseptic precautions were taken at the time of the operation and the socket healed up in a perfectly satisfactory manner. Nevertheless, the amount of sepsis was a contraindication, and apart altogether from the question of sympathetic disturbance, I would not use paraffin again under similar circumstances.

In this latter conclusion Ramsey is entirely correct, in my opinion. But I would go further and say that neither paraffin nor any other solid substance should be confined in the sclera or Tenon's capsule for the purpose of forming an artificial stump when septic conditions are present. First, because such operations usually fail from the severe inflammatory reaction and later extrusion of the solid body, and, second, sympathetic inflammation may follow as in the case reported by Ramsey.

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[3] Lancet, Jan. 31, 1903; Ophthalmic Rev., London, July, 1903.

Oatman,[4] Alter,[5] Sucker,[6] Spratt[7] and others who have used paraffin (especially paraffin with high melting point, 60° C. or higher) consider it, when used in a solid ball within the capsule of Tenon, the very best substance yet tried to form an artificial stump after enucleation of the eye. They claim (1) that it is non-irritating, (2) that it is least likely to be extrudated, (3) that the wound heals voluntarily if part of the substance should be extrudated (Oatman), (4) that the material is cheap and can be easily sterilized and made into the proper sized balls for insertion, (5) that there is no danger from breakage, (6) that the paraffin ball soon adapts itself to the shape of the cavity and is held in place by connective tissue growth into it.

As to paraffin being non-irritating, it is interesting to cite in this connection a paper by Dr. Robert Kirk,[8] entitled "Paraffin Cancer." Dr. Kirk reports several cases of epitheliomata occurring in workmen employed in refining solid paraffin in the mineral oil districts, while the shale miners and retort men employed in the same oil regions were free from such growths. In regard to those who work in refining paraffin having a tendency to epitheliomata he says:

> This held in particular some thirty years ago when the men came in contact with the paraffin. Superheated steam is now employed for refining the paraffin and as a result the men are not attacked with the growths that they formerly were. Formerly the men worked with bare arms and as a result many ulcers formed on the arms, most of them non-malignant, but a considerable proportion took on a malignant character, exhibiting all the characters, both macroscopically and microscopically of epitheliomata. Early excision gave always satisfactory results; but one case which was neglected resulted fatally. One patient, aged 71, had three such tumors removed successfully.

Dr. Kirk concludes: "These tumors were all epitheliomata, and the conclusion one must come to is that

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4. Medical Rec., 1903, lxiii, p. 372.
5. Ophthalmic Rec., March, 1903.
6. Ann. of Ophthal., January, 1903.
7. Arch. Ophth., 1905, xxxiv, No. 2.
8. British Med. Jour., 1903, ii, p. 1528.

long-continued irritation certainly does predispose to the production of malignant disease."

The keratosis of the skin produced by the injection of paraffin beneath the skin and the pathologic changes which result therefrom bear a strong suggestion of malignancy, which certainly lends some degree of probability to Dr. Kirk's conclusions, and also that paraffin may act as such irritant. The conclusions of Dr. Heidingsfeld[2] in the paper already cited are significant in this connection, to wit:

> The changes of paraffin prosthesis indicate that the paraffin is slowly removed and gradually replaced by fibro-connective tissue. Its removal is effected by phagocytosis, by means of successive invasion of inflammatory leucocytes and their successive degenerations. The prosthesis acts as a foreign body by its mere presence, and becomes promptly encapsulated with newly formed fibro-connective tissue. It stimulates the surrounding tissue to proliferation and adenomatous changes resembling those of early malignancy. The segregations of the encapsulated paraffin in rounded cavities give the conditions a characteristic Swiss cheese-like appearance, and the successive degenerations of invading phagocytes, corresponding with the duration of the process and the size of the encapsulated paraffin, are areas of flattened non-enucleated cells, giant cells, and fibro-connective tissue. These areas are separated by an areola of fibro-connective tissue, which gives to the whole prosthetic area an alveolar-like structure. Its analogy to tuberculosis is marked. The paraffin, like the bacilli, acts as a foreign body, incites a leucocytic invasion, which undergoes degeneration and caseation. This in turn excites another invasion with the formation of a large number of giant cells from the agglutination of the cell bodies and the preservation of the nuclei. The final goal of each is a complete fibrosis. The disappearance of the paraffin by oxidation or by its movement in solid form along lymph channels is improbable and not confirmed by histologic or physiologic facts. The histologic appearances also fail to furnish any special reason for the crystalline character of the paraffin favoring leucocytic invasion.

The dangers of embolism from injections of paraffin have already been pointed out by other writers, and I merely cite some of the cases reported to call attention again to this phase of the question. As a result of paraffin injections to correct nasal deformities, instances of embolism of the central retinal arteries or thrombosis of the ophthalmic vein with loss of vision have been reported. Leiser was the first to report a case of this nature.[9] The blindness in this case was supposed to be due to a thrombus of the ophthalmic vein rather than to an embolism of the central retinal artery. Following an injection of paraffin into the nose the patient suddenly became unconscious, but was revived by artificial respiration and by injecting stimulants. On recovering consciousness the patient noticed that he was blind in the left eye. The paraffin in this instance is supposed to have entered the ophthalmic vein through the *vena dorsalis nasi.*

Hurd and Holden[10] report a carefully observed case of embolism of the central retinal artery, the eye being observed twenty-five minutes after the injection of the paraffin for the correction of a saddle-backed deformity of the nose. In this case, as in the one reported by Leiser, the accident happened at the third injection of paraffin. A mixture of paraffin (130° F.) and ointment of white vaselin, having together a melting point of 110° F., of semi-fluid consistency, was injected by Dr. Hurd. Immediately after the injection the patient rubbed his right eye and remarked that he could not see with it. A little later ecchymosis appeared about the tip of the nose, indicating that a vein had been punctured. On examination by Dr. Holden twenty-five minutes after the injection the right pupil was large and did not respond to light, and, while there were subjective symptoms of objects, there was no objective perception of light. The ophthalmoscopic examination showed the retinal veins normal, but the main inferior branch of the central artery of the retina and its branches were empty and collapsed. The main superior branch contained some blood, but when gentle pressure was made on the eyeball the blood column was broken up and the blood flowed backward into the central artery. Treatment consisted in stimulating the circulation with digitalis, dilating the peripheral vessels by inhalations of nitrate of amyl and deep massage of the eyeball. After two hours of such treatment the retina was entirely bloodless, due to the deep massage of the eyeball, but the embolism was not dislodged. The margins of the disc were slightly blurred and the retina near the large blood vessels was hazy. Three hours later blood had returned to the retinal veins and in broken columns to the superior artery. The usual cherry-red spot was present at the macula. Vision was not restored.

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[9] Vereinsbeilage der deutschen med. Wochschr., April 3, 1902.
[10] Medical Rec., July 11, 1903.

Just how the embolism was conveyed to the central retinal artery in this case the authors are unable to explain.

Dr. Evan Evans who kindly made a physical examination of the patient, suggested the possibility of there being a persistent foramen ovale between the two auricles through which the solid body entering the veins might pass from the right to the left auricle and, avoiding the pulmonary circulation give rise to a crossed or paradoxical embolism, so-called, somewhere in the general arterial circulation. Since communication of considerable size between the auricles is not infrequently found at autopsies this explanation seems possible.

Injections of paraffin into other parts of the body have resulted in pulmonary embolism. Pfannenstiel[11] reports such a case in which he had injected a large amount of paraffin (113° F.) around the neck of the bladder to relieve incontinence of urine. Coughing, vomiting, chill, rapid respiration with cyanosis and dyspnea developed after the patient left the hospital; fortunately the patient recovered. Pfannenstiel is of the opinion that pulmonary embolism was responsible for these symptoms as a result of the injection of paraffin. According to Kummel, cited by Hurd and Holden, fatal cases of pulmonary embolism have been observed as a result of paraffin injections.

Sloughing of the tissues due to the injection of too much paraffin, or to the injection of paraffin into scar tissue, are other complications of a less serious nature which have been reported.

Taking into consideration the fact that sight may be destroyed, and that life itself may be sacrificed from the injection of paraffin into the tissues to correct slight deformities, or to make the patient more comfortable, it seems to me worth while to call attention again to such dangers. Certainly all mishaps from the use of paraffin injections should be reported that the technic may be improved or the method abandoned if it proves unsatisfactory or too dangerous.

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[11] Centrbl. für Gyn., 1901, 11, p. 33.

MYOPIA ASSOCIATED WITH OPACITIES OF THE CORNEA.*

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Although the association of myopia with opacities of the cornea, as well as with opacities of the crystalline and its envelopes, has been recognized for over a half century, little mention of this fact is found in modern ophthalmic literature. Among the authors of recent ophthalmic text-books in English, it is practically ignored.

The prevalence of corneal opacities in the cases of myopia studied in the older Continental schools and clinics is most striking to a modern American ophthalmologist. The statistics of Cohn[1] show a percentage of nearly 100 in school children. Among Arlt's[2] patients the association was found in 70 per cent. Additional published statistics are as follows: Chauvel,[3] 49.7 per cent.; Petersen,[4] 48 per cent., and Frenkel,[5] 38.5 per cent. Among other writers on this subject are Donders, Nicati,[6] Werth, Landolt,[7] Gelpke,[8] Roure,[9] Manguis,[10]

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[1] Untersuchungen der Augen von 10,060 Schulkindern, Leipzig, 1867, 156.

[2] Die Krankheiten der Augen, Prag, 1855, i, 260; iii, 217, 242.

[3] Etudes ophthalmologiques. Recueil d'ophthalmol., 1892, 586; 1893, 211.

[4] Ueber Hornhautflecke als Ursache der Myopia und Anisometropia, Kiel, 1887.

[5] Sur les Rapports de la Myopie avec les Taies de la Cornée, Annal. d'ocul., Paris, 1904, cxxxii, 174.

[6] Gaz. hebdom. de Méd. et Chir., 1879, 695.

[7] Arch. d'ophthal., 1884, 1.

[8] Die Augen d. Elementarschüler z. Karlsruhe, Tübingen, 1891.

[9] Myopie, Cataractes centrales et Leucomes centraux, Annal. d'ocul., Paris, 1896, cxiii, 393.

[10] Contribution à l'étude de la Myopie monolaterale. Thèse de Paris, 1893, 94.

Hess,[11] Fortin,[12] Garipuy,[13] de Lapersonne, and Widmark.[14]

Donders observed frequently the betterment of vision by concave lenses in cases of corneal opacity, but I can find no evidence to show that he recognized the production of a true axial myopia. The beneficent effect on vision was likely attributed to the increased accommodative effort and the consequent contraction of the pupil, diminishing the amount of diffuse illumination. However, Van Wyergarden,[15] a pupil of Donders, in 1854, records the case of a patient, blind since infancy in one eye with pronounced corneal opacities in the other, making it necessary for him to work at very close range, who gradually developed a high degree of myopia. He also mentions a man of 42, who improved his vision, dulled by corneal opacities, first by a stenopeic slit, and finally by concave lenses.

Arlt[2] discussed the rôle of central corneal and lenticular opacities in his celebrated Hand Book. Arlt had an especial interest in this subject, as his own brother suffered corneal opacities in a hyperopic eye, following smallpox in infancy. At the age of 13, this eye became myopic, gradually increasing in ametropia during his student life until it developed a myopia of 1/6. The other eye remained hyperopic.

Several of the early writers attributed the myopia to the increased curve of the diseased cornea. von Graefe[16] recognized the existence of a true axial myopia in these cases, and, in common with Arlt, advanced as a reason the closeness to the eye with which objects were held in order to increase the size of the retinal images, thus supplementing their want of clearness. The later statistics of Petersen and Fortin, showing a large percentage of double myopia in cases of unilateral opacities, seemed to further confirm the theory of excessive convergence as the chief etiologic factor in the myopogenesis. As will be seen later, the observations of H. Frenkel and Widmark point strongly to the accommodative strain as the

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11. Handbuch d. g. Augenheilk., 1902, ii, 338.
12. De la Myopie acquise dans l. Lesions cicatricelles de la Cornée, Paris, 1902.
13. Du Rapport d. Taies de la Cornée avec la Myopie, Toulouse, 1903.
14. Contribution to the Etiology of Myopia, British Med. Jour., 1902, ii, 1345.
15. Arch. f. ophthalmol., 1854, 251.
16. Arch. f. ophthalmol., 1854, 298.

cause of the myopia. These observers cite many instances of unilateral myopia with unilateral opacities.

In his magnificent and classical study of the examination of the eyes of 10,060 school children, Cohn[1] found 211 children with corneal opacities following the so-called scrofulous affections. Nearly all were myopic, and in 91 there was well-developed posterior staphyloma. Twelve were not refracted. The statistics relative to the other cases are as follows:

51 had myopia of from 1.0 to 1.5 D.
57 had myopia of from 1.75 to 2.25 D.
40 had myopia of from 2.5 to 3.0 D.
26 had myopia of from 3.25 to 4.0 D.
16 had myopia of from 5.0 to 6.0 D.
6 had myopia of 7.0 D.
3 had myopia of 9.0 D.

In 1879, Nicati[6] found among the school children of Marseilles 15.5 per cent. with myopia; and of these a large number showed corneal opacities, pronounced astigmatism and lesions of the ocular fundus, diminishing visual acuity. In 1884, Landolt[7] called attention to the frequency with which corneal opacities are found associated with myopia.

In 1887, Petersen[4] found in the records of the Ophthalmic Clinic of Kiel reports of 186 cases of myopia with corneal opacities. In 120 cases the corneal lesions were bilateral; in 66, unilateral. Of the bilateral cases 76 (63.4 per cent.) showed double myopia, in 28 cases higher than 6.0 D. There were 8 cases of malignant myopia, and in 50 cases there was posterior staphyloma. Bilateral emmetropia was noted in 8 cases (6.7 per cent.), and bilateral hyperopia in 16 cases (15 per cent.). In 66 cases of unilateral corneal opacities reported by Petersen, myopia was found in both eyes in 22 (32 per cent.). In 9 of Petersen's cases the myopia was found only in the sound eye and in 2 only in the affected eye. There was double emmetropia 3 times and double hyperopia 13 times. In 1892, Chauvel[3] contributed an important statistical study showing conclusively that, besides astigmatism of the cornea, opacities of this membrane have a marked influence on the production of myopia. Of 349 cases examined in military service the opacities had appeared:

Between infancy and 5 years, 131 times.
Between 5 and 10 years, 60 times.

Between 15 and 20 years, 33 times.
During military service, 94 times.

In comparison the statistics of Fortin show the début of the corneal lesions in 23 cases before 20 years and in 12 cases after this age.

In 1893, Manguis[10] reported 180 cases of unilateral myopia, in 27 of which there were corneal opacities in the myopic eye. He attributed the myopia to ciliary spasm arising from reflex irritation of the corneal inflammation rather than to the use of the eyes at very close range. In 1896, Roure[9] cites several instances in which concave lenses markedly improved the vision of persons with central corneal opacities not completely obscuring the whole pupillary area.

Inspired by de Lapersonne, Fortin,[12] in 1902, presented a most comprehensive statistical study of 54 cases, in 26 of which the opacities were bilateral. Of these 16 showed myopia in both eyes (62 per cent.). In 28 instances of unilateral opacities there were 17 cases of double myopia (60 per cent.). The myopia appeared only on the sound side twice, and on the affected side 4 times. There was a total of 83 per cent. of myopia in the 28 cases of unilateral opacities studied, in comparison with a total of 40 per cent. in the earlier statistics of Petersen. In the second edition of the Graefe-Saemisch Handbuch, Hess[11] discusses the manner in which corneal and stationary lenticular opacities cause myopia, attributing it to the necessary bringing of near objects close to the eyes.

From notes of 6,000 cases in private practice, Widmark[14] made a study of 100 cases of anisometropia in which there was either myopia in one eye only of at least 2.0 D., or myopia in both eyes but with a difference of 2.0 D. While the purpose of the paper is to refute the prominence formerly given to excessive convergence in myopogenesis and to give proper credit to anisometropia and corneal astigmatism as etiologic factors, it contains much data distinctly relevant to the discussion of the rôle of corneal opacities in this connection. Widmark contends that when corneal defects occur in both eyes they are predisposing causes to double myopia, not on account of the excessive convergence required, but because both eyes are strained in the effort of near vision. On the other hand, he affirms that when the cornea of but one eye is affected its fellow only becomes myopic, because it assumes all the strain of close work. He believes that the affected eye may become amblyopic, divergent or convergent, or may even be enucleated without in any way influencing the course of the myopia in its sound fellow. In support of this contention he cites several interesting illustrative cases, in 4 of which unilateral opacities caused myopia on the sound side only. This is confirmative of the belief shared by Arlt, Werth and Petersen, and which is disputed by the findings of Fortin and Frenkel and, in a measure, by the statistics that I offer. Widmark argues that the chief cause of myopia is seeing "in a limited sense"—the perception in the yellow spot and processes connected therewith at the posterior pole of the eye. Any extra effort at discerning close objects quickly following on each other—as, for instance, in reading and writing—may lead to hyperemia in the ocular fundus, which some writers assume as the predisposing cause of the characteristic myopic changes at the posterior pole. In addition the accumulation of fatigue products may also have a deleterious influence on the intraocular membranes, the continued hyperemia leading to softening of the tissues, which yield to the intraocular pressure. The practical lesson from these observations is the great necessity of facilitating the work of the retina and preventing ocular fatigue by correction of the astigmatism, anisometropia, etc., adequate illumination, properly printed books, etc. Other hygienic measures are relatively unimportant in controlling myopogenesis in school children.

By far the most exhaustive bibliographic and clinical study of this subject is that by H. Frenkel,[5] of Toulouse, supplemented by the ophthalmometric measurements of his associate, E. Garipuy.[13] The cases were selected from 1,350 ophthalmic patients. Among the patients with corneal opacities there were found:

10 men and 20 women with myopia.
4 men and 4 women with emmetropia.
4 men and 5 women with hyperopia.

Of 22 patients with bilateral corneal opacities there were 14 with double myopia (63.6 per cent.), proportionately identical with the findings of Petersen and Fortin. There was unilateral myopia twice, and in 3 cases in one eye determination of the refraction was impossible. Of the 22 cases there were 19 instances of myopia, either unilateral or bilateral (86.4 per cent.). In one case there was practical emmetropia and in two cases hyperopia. In the 25 cases of unilateral opacity Frenkel found a preponderance of myopia on the affected side 11 times. In 2 cases the myopia was on the sound side. To summarize, there were 13 cases of myopia, 5 cases of emmetropia, 2 cases of double hyperopia, 3 cases of hyperopia on the affected side, and 2 cases of hyperoopia on the sound side.

Illustrative of the tendency to high myopia, Frenkel found myopia above 6.0 D. in 16 of the 78 patients with corneal opacities—a proportion of 20.5 per cent., as against 6.45 per cent. in all the cases of myopia (about 1,000) observed by Cohn among 15,490 patients from 1866 to 1886 (reported by Schlesinger[17]). This marked frequency of high myopia may be attributed to the greater liability to affection of the intraocular membranes of the posterior segment of the eyeball after serious disease of the anterior tunics—a fact established by the observations of Panas[18] and de Lapersonne. Frenkel also significantly mentions that he has found corrected visual acuity relatively better in the cases of hyperopia with corneal opacities than in those of myopia. It is considered justifiable to believe that certain lesions of the cornea and anterior segment of the eyeball have associated with them a disturbance at the posterior pole, which, by an ill-defined, but nevertheless real, process, results in a chorioretinitis which becomes a preponderating factor in the pathology of progressive myopia.

It has also been suggested in this connection that irritation of the ciliary body following corneal inflammation produces hypersecretion and disturbance of the equilibrium between the ocular membranes and intraocular tension, resulting in a veritable anterior staphyloma, such as is seen in some cases of congenital hydrophthalmos. Fortin claims to have observed several cases of myopia in which there was an exaggeration of the corneal curve resembling that of true keratoconus. The ophthalmometric measurements in Frenkel's cases, however, did not show any significant difference between the curve of the central corneal meridian in the myopic cases with corneal opacities and that of the cases of hyperopia or emmetropia with similar opacities.

A careful study of the relative literature, as well as personal observation, shows that in these cases the myopia may appear either in the sound or diseased eye, or in both eyes. Frenkel states that in the cases of unilateral opacity examined by him the myopia was most frequently unilateral, but not always in the affected eye. Moreover, in no instance of unilateral opacity with double myopia was the defect equal in the two eyes and imputable in both eyes to the corneal lesions. He believes that if the opacities of the affected eye do not markedly interfere with useful vision at close range this eye speedily becomes myopic. On the other hand, if the opacities greatly obscure vision, preventing satisfactory use of the affected eye, the myopia develops in the sound eye. He calls attention to the fact that, in addition to irregular astigmatism, corneal opacities produce a definitely measurable astigmatism, which averages 1.5 D. to 2.0 D., and which is a factor in the myopogenesis. This conclusion is the result of careful ophthalmometric measurements in cases of unilateral and bilateral corneal opacities with and without associated myopia.

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[17] Beitrage z. prak. Augenheilk., 1900, xlv, 127.

[18] Lecons de clinique ophthalmol. Recuelles par Castan, Paris, 1899, 157.

In 11 cases of high myopia, measurement of the anterior corneal curve showed an average astigmatism of 1.7 D. in the right eye and 1.6 D. in the left. In the cases of bilateral corneal opacities with myopia the average astigmatism in the right eye was 1.7 D.; in the left eye, 2.0 D. In the cases of unilateral opacity the average astigmatism in the affected eye was 1.6 D.; in the sound eye, 0.8 D. In the cases of opacities with emmetropia, the astigmatism was predominant in the eye with the opacities. In the cases with hyperopia, the average astigmatism in the affected eye was 1.3 D.; in the sound eye, 0.2 D. .

I have selected from my private case records for the last ten years 28 instances of corneal opacities associated with myopia; of these, 13 were males and 15 females, ranging in age from 10 to 60 years. In 22 cases the opacities were unilateral, in 6 bilateral. In the examination of my records, no myopia of less than 2.0 D. has been considered, and all cases of suspected lenticular myopia have been rejected. No attempt has been made to show the relative frequency of corneal opacities in general ophthalmic practice, and the refractive condition of all patients with corneal opacities is not considered. It is evident that there would be a great discrepancy between the statistics of an American private ophthalmic practice and a Continental clinic. The object of the paper is solely to set forth the rôle of corneal opacities in myopogenesis and to present interesting collateral and relative data. Of the 22 unilateral cases of opacity the myopia was double in 12 and single in 10. The myopia developed only in the sound eye in 5 cases and only in the affected side in 5. Of the 6 cases of bilateral opacities, in 2 the myopia was unilateral. In one patient with congenital bilateral central posterior capsular cataracts, the myopia was unilateral and the corrected visual acuity was equal and almost normal in the two eyes. In one case of bilateral opacities the myopia was unilateral and in the eye with least opacity. In one case of double opacities, the myopia was bilateral and greatest in the eye with the best vision. Of the 16 cases of bilateral myopia there was a difference in the two eyes of more than 3 D. in 6 cases.

Unfortunately the opportunity to observe continuously the development of the myopia has been limited, but in two cases repeated examinations extending over a decade are of sufficient interest to warrant recording. In 1897 the patient, a girl of ten years, came to my office complaining of poor vision in the right eye, which was found to contain several punctate corneal opacities. There was a history of repeated attacks of "sore eyes" and the conjunctiva showed marked evidence of argyrosis. The refraction under atropin was:

R.—S. 2.00—C.1.00 ax. 180° = 6/12 V.
L.—S. 0.25—C. 0.37 ax. 30° = 6/5 V.

Within the next two years there were several slight attacks of phlyctenular conjunctivities in the right eye which always yielded promptly to the ordinary treatment. In 1902 the patient complained of failing vision in the left eye. Under cycloplegia I found:

R.—S. 2.50—C. 1.00 ax. 180° = 6/7½.
L.—S. 2.00—C. 0.62 ax. 180° = 6/5.

The opacities gradually disappeared until the examination of the refraction under atropin in 1907 showed perfect visual acuity in both eyes, with the following refraction:

R.—S. 3.00—C. 1.25 ax. 180° = 6/5.
L.—S. 2.50—C. 0.50 ax. 180° = 6/5.

In this case, at first appearance, the myopia was distinctly unilateral and in the affected eye, but during the course of school work, notwithstanding repeated refractions and the rigid use of correcting lenses, an almost equal degree of myopia developed in the sound eye. Fortunately the corneal haze gradually disappeared in the right eye until the corrected visual acuity was ultimately practically as good as that of the left eye.

Another interesting case was in a boy of 10, who first consulted me nine years ago. There was a faint central corneal opacity in the left eye following a severe keratitis in early chilhood. Retinoscopic and ophthalmometric measurements showed 1.75 D. of hyperopic astigmatism at the vertical axis. The opacity was sufficiently dense and the cornea irregular in curvature to prevent vision better than 6/100, even with the correcting cylindric lens. The sound right eye was myopic to the extent of 1.5 D., but with the correcting lens visual acuity was perfect. During the last nine years the myopia of the sound right eye has gradually increased to 4.0 D., with no diminution of corrected visual acuity. The opacity in the left cornea has gradually diminished, allowing an increase of corrected visual acuity to 6/30, without, however, any noticeable change in the refraction.

CONCLUSIONS.

1. Central corneal opacities are a much more frequent cause of myopia than would be inferred from an examination of general ophthalmic literature, particularly the English and American text-books and periodicals. According to recent reliable Continental statistics, in at least one-third of the cases in which they are present, central corneal opacities produce myopia, although this average is likely higher than that found in American ophthalmic practice.

2. The myopia is axial and not dependent on alteration of the corneal curve. Ophthalmometric examinations do not show any significant differences between the corneal curvature of myopic eyes with corneal opacities and similar eyes in which the refraction is emmetropic or hyperopic.

3. The mechanism of the production of the myopia is analogous to that of the common form following astigmatism, anisometropia, etc., with the added predisposing factor of weakened ocular tunics by previous inflammation.

4. The association of disturbance of the chorioid and

retina of the posterior segment of the eyeball with inflammations of the anterior membranes is an important element in further reducing visual acuity in these cases. For a similar reason extensive fundus lesions are common, and the myopia is more likely to become progressive than ordinary.

5. Either unilateral or bilateral opacities may produce myopia, and the myopia produced may be unilateral or bilateral.

6. In the cases of unilateral opacity the myopia may be single or double. If in such cases the myopia is unilateral it may appear either on the sound or the affected side, but no definite rule can be established in this connection. However, it is likely that when one eye is used almost exclusively for close vision it will become myopic first or to a greater extent than its fellow.

7. In cases of bilateral corneal opacities the myopia is generally bilateral. When there is a marked difference in the amount of defect in the two eyes the greatest myopia is often found in the eye with the least corrected visual acuity. When the myopia is unilateral it often occurs in the eye with the least opacity.

8. The cases of unilateral myopia are strongly suggestive of the importance of ciliary strain rather than excessive convergence in myopogenesis.

9. In view of the strong possibility of resultant myopia, all cases of corneal disease, particularly the phlyctenular .affections of childhood, should receive prompt and continuous treatment, and prophylactic measures should be rigidly followed to prevent recurrences. After the subsidence of the inflammation energetic treatment should be adopted to clear up the opacities.

10. Of greatest importance in the prevention of the subsequent myopia is careful and repeated refraction of both eyes under artificial cycloplegia, employing both objective and subjective methods, and the constant use of correcting lenses.

11. All errors in ocular, personal and domestic hygiene that encourage the development of myopia should be corrected, and the patient should be kept in the best physical condition and most salutary environment.

FURTHER OBSERVATIONS ON RETINITIS PUNCTATA.*

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On the basis of ten personal observations, five cases reported to me by colleagues,[1] and a review of the literature, I presented to the International Congress at Lisbon in 1906 a paper on the Punctate Forms of Retinitis.[2] In this study I came to the conclusion that the term had been and could be applied to several different types of disease, which had in common merely the occurrence of white dots in the fundus but varied in significance and clinical history. These conclusions I can confirm and extend by a further study of some of my patients.

While a pronounced retinitis punctata albescens, as the term is used by Mooren and most of the writers, is a rare disease, the appearance of discrete and usually not numerous white or yellowish-white dots, apparently situated in the retina, is not uncommon. When these white dots are numerous, counting up into the hundreds, the ophthalmoscopic picture is a striking one. When they are few in number they are usually faint and not readily seen through a narrow pupil. They range in size from about one-half to one diameter of a retinal artery of the second order, are round or rounded, well defined even if faint, and are usually not close enough to any vessel to show how deeply they are situated. The white dots occur in both eyes, although often the two eyes are not involved alike. They are in many instances transient, though of long duration, and may hence be considered minute infiltrations. Perhaps they may be of a degenerative nature when permanent. The cases observed by myself or reported in literature can be divided into the following types of disease:

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

[1] I wish to thank Drs. Hotz, Faith and Wescott for their courtesy.

[2] Full abstracts of this paper have appeared in the Ophth. Rec., October, 1906, and Arch. of Ophth., November, 1906.

SIMPLE PUNCTATE RETINITIS.

I shall reserve this name for the cases which present retinal dots without other complications at the beginning or during the duration of the disease. In this form the dots are not numerous, a few to a dozen, rarely beyond a few dozen, more or less near the margins of the optic disk, to some extent spreading toward the macula, and as a rule one eye more involved than the other. The sight may be normal or slightly reduced, especially in the more involved eye. With normal sight there may be irritability or asthenopia. The latter is sometimes relieved by appropriate correction of an existing ametropia, which had previously not annoyed the patient. In most of the cases seen or collected by me rest of the eyes and hygienic management have caused the dots to disappear in the course of months.

Possibly the cases described by M. Gunn,[3] in which such dots of minute size were found without symptoms belong to this group. Gunn found this anomaly in seven members of one family. The etiology is not clear in any of the cases. The case which I have had the best opportunity of studying is worth quoting from the Transactions of the Lisbon Congress, especially as the patient suffered a relapse since my previous report.

CASE 1.—(Case 4 in the Lisbon Transactions.) *Patient.*—Mr. L., aged 36, of good health.

History.—Patient had a recurrent inflammation of left frontal sinus. Incidentally he mentioned that for two years past he had not seen as well with his right eye as with his left.

Examination.—R. E. V. = 20/50. Field normal. No scotoma. L. E. V. = 20/20. In right eye fine whitish dots scattered all over the central part of fundus, about ten in the macular area. In L. E. about six similar dots near the temporal side of disk. No other lesion. Under potassium iodid in large doses the sight of R. E. rose to 20/40 within two weeks. After six weeks there were apparently fewer spots in the macular area of R. E.

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[3] Trans. Ophth. Soc. U. K., vol. iii.

Six months later sight of R. E. normal. At that time as well as some sixteen months subsequently no dots could be found.

Subsequent History.—Mr. L. was seen repeatedly during the next year on account of transient left supraorbital neuralgia due to purulent inflammation of either the frontal sinus or the anterior ethmoid cells. The discharge as well as the pain yielded each time quickly to intranasal treatment. About 2½ years after the first examination he complained again of poor sight in the right eye, and admitted that the left was not perfect. V. was found =20/40+ in each eye, the R. E. being subjectively more dim. A fresh crop of white dots had appeared in the R. E., perhaps some 30 in number, at the temporal edge of the disk and again in the macular region. The left eye showed only three dots at the nasal side of the disk and a few scattered throughout the central area. No other ocular lesions. No scotoma. He had a slight purulent discharge from both sides of the nose, apparently from the anterior ethmoid cells. Iodid had no effect this time. The dots in both eyes increased moderately in number. Those near the papilla in R. E. enlarged in size so that several became distinctly elongated in shape. V. diminished in both eyes to 20/50, varying somewhat on different days. As iodid seemed to increase the nasal discharge it was stopped and only nasal irrigation and sprays were employed. About the fifth week decided subjective and later on objective improvement began. Still later the nasal discharge became reduced and intermittent, and finally ceased. At one time the sight of the left eye was not as clear as that of the right, although the spots were always more pronounced in the right. After four months vision became normal and the dots reduced in number were fading.

PUNCTATE RETINITIS FOLLOWING OPTIC NEURITIS.

Frost[4] has pointed out that dull white dots occur occasionally in the retina near the disk in the course of a neuritis. This I have observed repeatedly, most notably in an instance of unilateral optic neuritis of moderate severity in an adult in whom a small number of white dots persisted for some months without interfering with ultimate recovery. In my case books I have not noted these cases as retinitis punctata. The striking picture of retinitis punctata may, however, be brought on in the course of an optic neuritis, as observed by Dr. Faith in two instances kindly placed at my disposal by him.

Case 2 (Dr. Faith).—*Patient.*—Boy, aged 15, had complained for two weeks of headache and failure of sight. V. =⅛. Pronounced optic neuritis without hemorrhage. Slight fever. Urine normal. Under treatment (sweats, iodid of mercury) sight improved and a central scotoma became demonstrable. After two months V. = 6/9. As the neuritis disappeared numerous white yellowish pinpoint dots appeared around the disks verging toward the macula. In the course of a year they had almost disappeared with ultimate normal sight.

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[4] Fundus Oculi, 1896, p. 199.

Case 3 (Dr. Faith).—*Patient.*—Girl, aged 15, complained of headache and blurred sight. V., which had formerly been 6/5, was reduced to 6/9 in R. E. and 6/7.5 in L. E. Edges of disc blurred and vessels tortuous. Numerous small bright specks surrounding the discs. Moderate anemia.

Treatment.—Iron and aresnic were given and in two months vision rose to 6/5 and the fundus anomalies disappeared except the dots. The blood count became normal. A year later no anomaly was found, except a few faint dots below the disc in the R. E.

I wish to emphasize this relationship of retinitis punctata to optic neuritis, as I believe it furnishes the clue to the pathology of the larger number of instances reported in literature shortly after Mooren's first use of the name.

PUNCTATE RETINITIS AS PART OF GENERAL RETINAL DISEASE.

In the cases reported by Hirschberg,[5] Landesberg,[6] Burnett[7] and M. Standish[8] there were retinal exudates, vasular changes and hemorrhages in the earlier part of the disease. The patient of Standish showed especially well the evolution of the disease, viz., gradual failure of vision to 1/5, diffuse haze of the retina, becoming complicated by retinal exudate, and infiltration around the disk with tortuous vessels, whereupon a few retinal dots began to appear. On the course of a week's treatment all lesions disappeared except the dots, which continued to increase while sight became normal. The disease was almost always bilateral but not equally extensive in both eyes. All the patients had decided impairment of sight, usually in the form of a well-marked central scotoma. Some recovered completely, others only partially, with some optic atrophy. These latter incidents, the typical scotoma not explained by localized

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5. Centrlbl. f. A., 1882, 330.
6. Centrbl. f. A., 1883, 261.
7. Arch. of Ophth., 1882, xxii, 22.
8. Ophth. Rev., September, 1893.

retinal disease and the possibility of later atrophy, suggest strongly that a retrobulbar neuritis was present, probably as the most important of all the lesions. The presence of the white dots does not account for the scotoma; in fact, with a retina studded with these minute infiltrates vision may become almost perfect.

ATYPICAL FORMS OF RETINITIS ALBUMINURICA.

Two of my observations (Cases 10 and 11 in the Lisbon Transactions) could be interpreted as atypical forms of retinitis albuminurica due to pronounced kidney disease. In both the retina showed as the principal lesion the characteristic punctate infiltrates. Unfortunately, both patients did not stay permanently under observation.

PUNCTATE RETINITIS WITH INVOLVEMENT OF CHORIOID.

In some instances which can be called punctate retinitis there is some involvement of the chorioid. I can not say, however, whether this is primary or secondary. Dr. Hotz gave me the reports of two cases of transient white punctate infiltrates of the fundus with practically normal vision ending in recovery, which he interpreted as chorioidal disease, because in one of them there were fine filaments floating in the vitreous, while in the other chorioidal hyperemia during the course of the disease led finally to irregular mottling of the chorioid pigmentation. In one of my own observations of retinitis punctata, apparently due to kidney disease with diffuse retinal cloudiness and central scotoma, the sight steadily failed with the development of a diffuse opacity of the vitreous. I have also seen a case of a localized patch of areolar chorioiditis in which the white dots characteristic of punctate retinitis were scattered throughout the central area of the fundus.

ATYPICAL RETINITIS PIGMENTOSA.

The name retinitis punctata is at present, however, mostly applied to an entirely different form of disease which is probably an atypical variety of retinitis pigmentosa. These patients complain of more or less night-blindness, usually since youth. The central vision is sometimes normal, sometimes reduced. In some the visual field is restricted. There is often, but not always, consanguinity in the parentage. Several instances occurred in brothers and sisters. The greater part of the fundus, but not the periphery, is studded with minute dull white dots, while the macula is nearly free when central sight is still good. In many of the cases pigment figures were seen in the periphery of the fundus sometimes described as not characteristic of retinitis pigmentosa. In cases with reduced sight the nerve appeared moderately pale. It has been repeatedly observed that the disease can remain stationary for many years and that it progresses rapidly.

Cases of this kind have been reported by Gayet,[9] Dor[10] and Nettleship.[11] Fuchs[12] subsequently interpreted these cases as atypical retinitis pigmentosa. Further reports have since appeared by Liebrecht,[13] by Griffith,[14] also by Tr. Collins and Swanzy,[14] and Wuestefeld.[15] The latest of the same kind are reported by Wicherkiewicz[16] and by Takayasu,[17] who saw two instances in Japan.

CASE 4.—*Patient.*—Miss L., aged 29, anemic, complained of headaches, especially in the afternoons, and of fatigue of the eyes. Did not see well at night.

Examination.—V. R. E. = 20/20; L. E. = 20/40, improved to 20/30 by Cyl. + 1, axis 135. Homatropin showed in addition H. = 1 D. in both eyes. Nerves and vessels normal. Near but not quite at the periphery of the fundus was a zone showing pigment figures in the form of delicate branching threads. In the L. E. there were two dozen white specks in the more central part and several areas of exceedingly fine white dots. A fainter dotting was also seen in the R. E. The headaches were permanently relieved by appropriate glasses. No change after one year.

Subsequent History.—Eight years later I saw the patient again. Her night-blindness was a trifle more troublesome, but her central vision was as good as formerly. The fields were still perfect. The ophthalmoscope showed no certain change in the appearance of the retinal pigmentation. The white dots, however, could no longer be found.

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9. Arch. d' Ophth., iii, 386.
10. Id., 481.
11. Trans. Ophth. Soc., U. K., iv, 162; vii, 301; viii, 163.
12. Arch. f. Ophth., 39, iii, 65; and Arch. of Ophth., 1888, xxvii, 484.
13. Klin. Monatsb. f. A., June, 1895.
14. Trans. Ophth. Soc., U. K., 1897.
15. Ztschr. f. A., v, 2.
16. Trans. of Lisbon Congress.
17. von Graefe's A. f. Ophth., lxiii, 281.

The case can not be considered ordinary retinitis pigmentosa on account of the atypical form of pigmentation as well as the persistence of practically normal vision for eight years in a patient now 37 years of age. As far as I know this is the first instance of this form of retinitis punctata watched during such a long time, and also the first in which the white dots have ultimately been found to disappear.

INDICATIONS FOR THE EMPLOYMENT OF ADRENALIN CHLORID, IN CONJUNCTION WITH COCAIN, IN OPERATIONS ON THE EYE.*

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For several years, as a matter of routine, I have been employing adrenalin chlorid in conjunction with cocain in many operations on the eye. At first this was done solely to lessen hemorrhage, but for some time I have used it not only for this purpose but because it soon became evident that through its action the anesthetic effect of the cocain was definitely increased.

In operations on the cornea and conjunctiva the anesthesia produced by cocain is, as a rule, so complete as to leave little to be desired, but this can not be said of certain other operations, notably those on the ocular muscles, on the lacrimal apparatus, and those done for the cure of chalazion or other tarsal cysts. Here, where much is to be desired in the direction of more perfect anesthesia, adrenalin has proved of undoubted value.

That adrenalin used in conjunction with cocain facilitates, in a mechanical sense, the passage of probes through the occluded lacrimal duct has not been evident to me, but that it renders the introduction of the probes, as well as the slitting of the canaliculus, less painful is hardly open to question. There can be as little question, I think, that chalazion operations in like manner are made much more tolerable than are those in which cocain only is used.

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In tenotomies of the ocular muscles the hemostatic action of adrenalin is of great advantage, though it must be confessed that it does not always as effectually control hemorrhage from the divided tendon as it does from the conjunctival incision. In addition to this effect, however, I am sure that it makes the operation—especially the cutting of the tendon and the manipulations with the strabismus hook—decidedly less of a tax upon the fortitude of the patient.

In operations involving the making of a corneal section, especially cataract extractions and iridectomies, with the exception of iridectomy done during an attack of inflammatory glaucoma, experience has taught me to be rather chary in using adrenalin. For, though I have employed it several times in cataract extraction with no ill effect, I have felt more than once that the operation was complicated by its use. Particularly was this true of one case in which, immediately after the completion of the section, the cornea lost its transparency to a remarkable degree and collapsed in crater-like fashion, the further steps of the operation thereby being rendered decidedly more difficult. In such operations, too, there seems to be no definite reasons for employing adrenalin, since the anesthesia from cocain alone is usually satisfactory.

This last observation does not apply, however, to iridectomies performed for the control of inflammatory glaucoma. Here, as is well known, the anesthesia from cocain is often far from satisfactory. For this reason, and because, moreover, the astringent effect of adrenalin is decidedly helpful, I have preferred to use it under such circumstances. It is interesting to note that Professor Fuchs, of Vienna, has been led by his experience to a similar conclusion.

In operations for pterygium, adrenalin seems to me to be contraindicated, because its blanching effect renders the outlines of the growth difficult of recognition, and, besides, the anesthesia from cocain alone is all that could be wished for.

Dr. J. Elliott Colburn[1] has pointed out another valuable indication for the use of adrenalin in conjunction with cocain. In several cases of ocular traumatism the instillation of adrenalin, by checking hemorrhage, greatly facilitated the detection and removal of foreign bodies which were imbedded in the superficial structures of the eye.

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[1] Clin. Rev., July, 1901.

Although I have usually employed adrenalin in full strength (1:1000 solution), and, especially in probing the lacrimal duct, have applied it to the same eye repeatedly and freely, I have never seen any untoward consequences—except such as I have referred to—from its action. I have also found that its sterilization, by brief boiling in a Florence flask, in nowise impairs its efficiency.

There seems to be good authority for the claim that the toxicity of cocain is markedly lessened through the action of adrenalin, but in the eye surgery this is not a matter with which we are much concerned.

In conclusion, I may add that as a therapeutic agent, *per se,* in the treatment of inflammatory conditions of the eye adrenalin in my hands has not proved efficacious.

THE PREVENTIVE TREATMENT OF TRANSFERRED OPHTHALMITIS.

(SO-CALLED SYMPATHETIC OPHTHALMIA.)*

CHARLES A. OLIVER, A.M., M.D.
PHILADELPHIA.

For many months I have been engaged in the collation of the histories of all of the recorded cases of every form of so-termed "sympathetic disease"[1] that had been treated in the dispensary and indoor services of Wills Hospital in Philadelphia since its opening, a period embracing more than seventy years.

During these studies—in which I received excellent help from three of my personal assistants[2]—I soon realized that in spite of a vast yearly increase of the work done at the hospital and a broader and earlier recognition of the condition, there was a decided lessening in the number of cases, and a much less degree of fatality among those which had been treated than in former years. These findings seemed so important that I instantly chose the preventive phase of the disease as worthy to be the subject of this paper.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

[1] As I have elsewhere stated, for several years past I have taught my classes and private students that so-called "sympathetic irritation" and "sympathetic ophthalmia" are simply different stages of a condition which is preferably termed "transferred ophthalmitis." I believe that the expression "sympathetic," as ordinarily understood in this connection, has no significance whatever, and I am certain that the term "irritation" is just as false; it must be conceded also that the word "ophthalmia" should not be applied to any form of inflammation of the interior of the eyeball. The word "transferred" is correct, no matter what the process may be, and the generic term "ophthalmitis" is both adequate and comprehensive.

[2] Drs. S. Rush Ketcham, Albert J. Britt, and Ida Louise Haverstick.

The many desultory, and at times uncertain, cases of the first thirty-five years' work of the hospital were grouped together, while the latter half of this portion of the hospital's work, which had been systematically arranged into annual groups, was divided into periods of time similar to those which I had used in a study of several thousand cases of extraction of senile cataract.

Critical inquiry into the detailed histories of the cases elicited many points of value. For example, it was found[3] that, in spite of a vast increase of the types of cases which are ordinarily supposed to be provocative of the condition (some 62 per cent.), the proportionate number of cases seen was actually reduced nearly 80 per cent. within the past ten years. This is a remarkable improvement and one which is worthy of special record, when it is considered how long the institution has existed, that it is situated in the midst of a large industrial and commercial center, that it is near to an immense mining territory and agricultural district, and has always been favorably known—reasons, which, for many years past, have been the means of bringing from ten to fifteen thousand new eye cases annually to its doors.

Employing the title "preventive treatment" as it should be employed, i. e., to express both the indirect and the direct preventive measures for lessening the chances of occurrence of the disease, I here offer some of them in brief detail under their two respective headings.

INDIRECT CAUSES.

1. More improved and better constructed machinery, which, as a rule, has contrivances for the rapid and the safe removal of extraneous and useless débris, etc.

2. More carefully arranged, more sanitarily built, and more adequately illuminated factories, mills, shops, etc., than formerly.

3. A broader compulsory employment of personal protectives by the workmen during their occupations (as was found by comparison and contrast of the conditions prevailing at the different places from which the patients came).

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[3] As noted in the "Discussion on Sympathetic Ophthalmia," before the 1906 (seventy-fourth) annual meeting of the British Medical Association, Toronto, Ontario.

4. More prompt search for and amelioration of the original disturbing conditions. Study of the cases showed that for the past ten years the time elapsing between the onset and the first examination and treatment had greatly lessened; this in great measure having been the result of the present realization of the value of speedy relief, and the increased ease of railway communication between distant centers and the hospital.

5. Better personal condition of the patient. This was so pronounced that in many cases prognoses could be determined in great measure after a cursory inspection of the general appearance of health and cleanliness of the patient; this in addition to the race, the nationality, the sex and the age—all of which serve as greater prognostic factors than is ordinarily believed.

6. A better arrangement on the part of the hospital for immediate attention to first aid applications and remedial measures to every case that is brought to the institution. For the past six years there has been an efficient medical officer constantly on hand to attend promptly to any case applying, while two or more of the surgical staff are nearly always to be found within a few minutes' time for personal advice and action.

7. A higher grade of skill on the part of those in charge of the cases than formerly. This has been obtained through a vast increase, and now almost constant repetition, of similarly affected cases.

A better equipment, always available, of all of the modern instruments and appliances known, thus allowing more or less positive results for good to be obtained within the briefest periods of time after the admission of the patient.

DIRECT CAUSES.

9. An increased certainty in intelligent action by the early employment, if necessary, of one of the most exact methods of *x*-ray studies in the country.

10. The prompt removal, whenever possible, of any foreign body from the interior of the eyeball by the methods which have been found to be the latest and best adapted for each special case.

11. A greater tendency toward the early removal of shattered and useless eyeballs of dangerous types by the simplest and the least complicated methods of operative procedure.

12. A better preparation of the patient for—as nearly as may be possible—aseptic operative measures or special remedial treatment in the wards of the hospital, every case being subjected to the best and the least disturbing cleansing processes for both skin and mucous membrane, each case being isolated, as far as practicable, by being placed in bed, and every affected eye being promptly treated for prevention or lessening of reaction and reduction of inflammation.

13. A more prolonged continuance of controlled therapy than formerly, thus ensuring an increased probability for permanent quiet and a greater chance of escape from subsequent disturbance.

14. Better facilities for guard over the cases for long periods of time, each patient always being personally requested and whenever possible required, through his employer, to report at fixed intervals for careful restudy of the remaining conditions.

1507 Locust Street.

PREMIUMS PAID TO EXPERIENCE.*

[A critical study of 5,000 consecutive cases seen in private practice with a tabulation of the different ocular diseases which have been under observation, an analysis of some of the results obtained by treatment, and a résumé of the knowledge and experience gained in certain lines of ophthalmic practice.]

BY FREDERICK T. ROGERS, M.D.

ASSISTED BY GEORGE W. VAN BENSCHOTEN, M.D.

PROVIDENCE, R. I.

In twenty-five years of active work in the practice of medicine there has accumulated a vast storehouse of experience, from which may be drawn guidance in the problems of our life, as well as knowledge which prevents the repetition of mistakes and acts as an incentive to better effort.

Several years ago, actuated by curiosity to learn how many of my patients with diseased conditions of the posterior section of the eye received any marked benefit from treatment, I began this record; the opportunity to present to this Section the results of personal observation prompted me to complete the series of cases and, with the valued assistance of Dr. George W. Van Benschoten, to offer the results of our labor.

It is my aim to state, as briefly as possible, some of the lessons I have learned, not to pose as author or teacher, neither to magnify my successes nor to belittle my failures, but, with the greatest respect for the opinions of others, to offer a paper based solely on my own experience. Pardon is asked for the necessary frequent introduction of the ego.

The cases selected are consecutive, but are taken from records of different years extending from 1890 to 1907, and they are classified according to the predominant pathologic condition, in general assumed to be the one for which the patient sought advice.

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TABULATION OF CASES.

Anomalies of:	
Refraction	3,188
Extrinsic muscles	157
Diseases of:	
The lids	176
The conjunctiva	387
The cornea	349
The lens	150
The lachrymal apparatus	66
The sclera	20
The iris	116
The chorioid	53
The retina	97
The optic nerve	55
The globe	40
Glaucoma	39
Amblyopia	27
Sundry diseases and conditions	80
	5,000

RELATIVE IMPORTANCE OF REFRACTION.

The most impressive fact of this study is the relatively large number of cases of refraction. Of my patients 67 per cent. have sought or needed correction for ametropia, and there is no reason to believe that my experience is exceptional.

It would seem that the pathologic conditions which occupy nearly three-fourths of our time should receive adequate discussion in our scientific meetings and that current literature should show the importance of this branch of our work, but as a matter of fact the number of papers on this topic which have been presented to this Section during the last five years is but 20 in a total number of 165, and of 621 original communications in ophthalmology during the year 1906 but 58 were on this subject, and of 21 articles on eyestrain 16 were by one author. If we knew all that there is to know about refraction, or if the action of the extrinsic ocular muscles could be definitely stated under all conditions, then this plea would fail of significance, but however much I disagree with some of the statements of my friend, Dr. Gould, I wish heartly to endorse what he has said regarding the importance of accurate mensuration of refractive errors and to decry the neglect on the part of the profession to give anything like adequate attention to this part of our work.

It is true that many of us at times do very bad work; were it otherwise those cases of hyperopes wearing concave lenses, of undiscovered and uncorrected astigmatism, of cylinders placed at improper axes, of unrelieved asthenopia which come to us from reputable men, and the same cases which escape our attention and go to the other man, would not occur so frequently. There is a true refractive correction for every ametropic eye and—within certain small limits—this should be discovered and measured by every man in the same way. This diversity of results accounts for a second fact impressed on us in a general view of these cases, and that is that the length of time that the average patient is under our observation is very short. Two or three consultations and the patient is gone, if relieved, to return in some years with an increasing presbyopia or an idea that his glasses need changing; if unrelieved, to go the rounds of the profession seeking the relief that we vainly tried to give.

When we *know* about refraction our patients will cling to us long enough for us to remember their names without recourse to our records, and will be in reality patients instead of customers.

ERRORS OF REFRACTION.

In correcting errors of refraction the desideratum has been the comfort of the patient and the relief of asthenopia with the maximum degree of vision and not the absolute correction of every deviation from the emmetropic eye and this allows for the hyperope at times a full correction, at others a partial one, a recognition of the fact that the axis of an astigmatism for close work is not always the same as for distant vision, a varying limit of presbyopic correction and the avoidance of any hard and fast rule, it should insure as complete and exact knowledge of the ametropia as possible but allows a prescription varied to meet the habit or idiosyncrasy of the patient.

REASONS WHY INCORRECT RESULTS ARE OBTAINED.

There are three reasons why different results are obtained in the same patient by equally competent observers.

1. *The Personal Equation of the Examiner.*—There is nothing more likely to cause failure than hurry. We can not do good work and do too much. The estimation of refraction is a painstaking task, and it is the salvation of the young man that he can afford the necessary time to discover what we in our haste overlook, and his practice grows accordingly till he in turn also gets too busy for accurate work, when it passes to another. When I do not readily work out the problem under consideration I have learned to stop and to try again another day. It is better to impress your patient with your desire to be thorough than with your ability to do quick work.

2. *The Personal Equation of the Patient.*—In estimating the visual acuity it is essential that we learn and record the maximum degree of vision; the ordinary methods of examination are faulty in this respect, because the average patient does not understand that this is what we desire. Placed before the ordinary types he is asked to read the lowest line that he can, as the element of time precludes our asking him to read all the letters on the card, but in nine cases out of ten he reads a line or two above that which represents his maximum vision and it is only by repeated questions and trials that we finally gain the desired result. If our record is made without this protracted effort it is erroneous and subsequent tests will show a discrepancy.

I have for several years used the Monoyer card with the metric system. This is so arranged that I can illuminate each line at will, and I always start with a line that I think the patient can not read and in turn bring before his vision the larger letters till he reads them correctly. There is just as good reason for this as there is—in the measurement of the prism strength of the ocular muscles—to start with the stronger prisms first, and this Section has already stamped that method with its approval.

3. *An Appreciation of the Actual Need of the Patient.*—It is an every-day experience for all of us to have patients say that they are unable to wear the glasses which have been prescribed for them by some other oculist, and it is my frequent experience to find that this is due to a failure to ascertain for what purpose the glasses are to be used. The patient may be a weaver with a near point 20 to 30 inches from the eye, a seam-

stress with a working distance of 18 to 20 inches or a die sinker or engraver working at a distance of only 8 or 10 inches; in such a case to give a presbyopic correction estimated for the ordinary reading distance insures failure. Musicians, typesetters, linographers, etc., require glasses different from those appropriate for students, professional and business men of the same age.

A knowledge of the general condition of the patient, his power of accommodation for each eye, his ability to use it for prolonged effort, a consideration of the nervous tone present and the possible tendency of the patient to complain of trivial symptoms, as well as the existence of that form of neurasthenia which magnifies every ocular symptom and seeks for relief from every possible pain and ache by spectacles, are factors to be considered quite as much as the mechanical measurement of the ametropia.

CYCLOPLEGICS.

In my experience the use of a cycloplegic has become a necessity and no method is alike so accurate in results and so comfortable to the patient as the gelatin discs devised by Dr. Wood. I have measured the hyperopia in fifty young persons under homatropin and later under atropin, and the maximum latent hypermetropia developed under atropin over that shown with the weaker drug was in one case 2.5 D., in two cases 2.0 D., in four 1.0 D., and in all the rest varying amounts from 0.25 D. to 0.75 D. Between the method of using the discs and the frequent instillation of an aqueous solution there is not enough difference in results to pay for the annoyance it causes the patient and the time it occupies. I have used homatropin in over 20,000 cases in private and hospital practice and I have seen glaucoma follow its use but once, and I have always felt that the symptoms first presented were those of an oncoming attack of this disease which I mistook for asthenopia.

EFFECT OF A CHALAZION ON VISION.

In the literature on the subject I have not seen the fact mentioned that the presence of a chalazion sometimes causes a marked diminution of vision and a decided change in the axis of any existing astigmatism. In this series I have seen two cases which show this to be true. Both were patients who had been under observation for a number of years, and in each I knew the exact refractive error and more than once have I seen the vision fall from normal to 0.4, although improved by a change in the axis, yet in 24 hours after the removal of the retention cyst again become normal under the original correction.

FOGGED VISION.

I have been much interested in Dr. Dixon's theory of "fogged vision," and in a score of intractable neurasthenics I have followed the plan of keeping the vision a little below normal by overcorrecting the manifest hypermetropia, but I have failed utterly to gain the beneficial results claimed by the author, although I admit the value of the method in estimating the amount of latent error. The asthenopic symptoms have, as a rule, been rather increased and the constant feeling of effort which is engendered is not conducive to the comfort of the patient and comfort is what we seek.

VALUE OF REPORTS OF CASES.

It is a source of wonder to me how certain men can get results from the correction of ametropia which others with the same methods can not obtain, and I believe that many cases are reported as relieved when they have merely passed from observation and they are assumed to have been cured. Even if pains are taken to write to the patient and inquire as to the present condition, the answers are not always reliable. I have addressed such letters to several hundreds of patients and have flattered myself that my results were eminently satisfactory, only to learn afterward that a dislike to hurt my feelings has prompted many of them to report themselves as cured when they were even then under treatment elsewhere for the same condition.

In a recent article on migraine in the *Ophthalmic Record* the relief by proper glasses is so extraordinarily uniform that I believe the replies are not to be relied on and the force of any conclusion is necessarily weakened.

CHOREA AND EPILEPSY.

Two cases of chorea and one of epilepsy were referred to me in this series of cases for examination, and in none were found that error of refraction or muscular trouble which is so frequent in the reported cases of those who assume that such errors are a factor in the etiology of functional nervous diseases. Some years ago, at the request of the late Dr. Keene, I examined a large number of these cases in the state institutions at Cranston, R. I., and I have records of over a hundred choreic and epileptic patients in private practice. I have done tenotomies, as well as graduated tenotomies, and in but two cases have I seen improvement enough to warrant the assumption of any therapeutic value in the operation. I have under my care two epileptics who have been reported as cured by tenotomies, but the condition is quite as bad as before the cure.

LATERAL SPINAL CURVATURE AND OBLIQUE ASTIGMATISM.

Two cases have been seen which bear out Dr. Gould's statements of the effect of oblique astigmatism on spinal curvature.

CASE 1.—Oct. 7, 1901, H. H., aged 17, American school girl, complained of pain through eyes and head extending down the back and aggravated by study. Some months previously her physician had noticed a lateral curvature of the spine and an attempt had been made to correct this deformity by the daily use of calisthenics. She was wearing glasses given her by an optician, O. D. + 0.50 C. 90° — O. S. + 0.75 C. 90°, and with them got 0.7 vision, but there was noted at once a tendency to tilt the head to one side when using them. Under a mydriatic the vision was as follows: R. V. = 0.1 + 1.75 (+) 0.50 C. 75° = 1.0; L. V. = 0.2 + 1.25 (+) 1.0 C. 100° = 1.0. She was ordered O. D. + 1.0 (+) 0.50 C. 75°; O. S. + 0.50 (+) 1.0 C. 100°, for constant wear.

April 19, 1902. The patient had improved greatly; the asthenopia was gone and the spinal defect was not noticeable. The gymnastic exercise had, however, been continued and the beneficial result was attributed to this alone.

CASE 2.—May 31, 1902, Mrs. H. F., aged 36, had poor vision. When reading had a sensation as if the right eye were being pushed forward, with pain extending to neck and shoulders, and there was a desire to turn the head to the right; she was a neurasthenic; had recently had an ovariotomy performed and was just from Dansville Sanitarium, where she had been treated for spinal curvature. R. V. = 0.7 under a mydriatic = 0.1 + 2.50 (+) 0.50 C. 45° = 0.8; L. V. = 0.5 under a mydriatic = 0.1 + 1.50 (+) 1.75 C. 165° = 0.9. I ordered + 2.0 (+) 0.50 C. 45°; + 1.0 (+) 1.75 C. 165°, for constant wear.

Feb. 3, 1905. There had been no complaint of spinal trouble since wearing glasses and the asthenopic symptoms were entirely relieved; she was still neurasthenic and had recently had

an operation for floating kidney, but the lateral curvature was not present, although when the glasses were laid aside she assumed the same position noted in 1902, and there was soon felt the discomfort referred to one eye.

FULL CORRECTION IN MYOPIA.

I have had an opportunity in this series of cases to watch five cases of "school myopia" for periods of over ten years. In four of them full correction, the occasional use of atropin during vacations, attention to hygienic rules and an increase in the strength of the lenses as the myopia increased, at least twice a year, so affected the myopia that the yearly increase was in a constantly diminishing ratio. In each it resulted in a condition of moderate myopia which has been stationary for some years. In one case the increase in myopia was at the rate of one-half diopter every six months for nearly two years. Four years then elapsed without attention and the myopia during that time increased nearly seven diopters and in the three following years to 12 D., since which time it has remained stationary. My experience in these troublesome cases has been uniform, and I am a firm believer in the full correction.

CONVERGENT STRABISMUS.

There have been 70 cases of convergent squint, and of these I have been able to follow 60 cases long enough to note the ultimate result of treatment. In some of them (8) the age of the patient precluded an accurate test of vision, and reliance was placed entirely on retinoscopy in estimating the refraction and the existence of an amblyopia could only be surmised. I have attempted to classify them as follows:

Patients.	Success.	Partial Success.	Failure.
In which there was amblyopia and the vision of the squinting eye was not improved to more than 0.1....	..	2	8
In which the vision of the amblyopic eye was materially improved by glasses	4	5	5
In which the vision with correcting lenses was nearly equal in each eye. In most cases alternating squint	12	5	6
Tested by retinoscopy only.........	1	2	5
Tenotomy or advancement	5	..	..
	22	14	24

Some of the 24 unsuccessful cases ultimately came to operation, but, with one exception, the original tenotomy was done for the cosmetic effect alone. In the successful cases the correcting lenses were worn for some years, and the fact that when they were removed the squint returned was not considered a reason for calling the case unsuccessful. The treatment was, 1, as nearly a full correction as possible; 2, the frequent use of atropin; 3, the occlusion of the fixing eye for definite and regular periods, and, 4, the cultivation of the fusion sense by systematic exercises. Experience has taught me that there are two classes of cases where persistence in non-surgical measures will effect a cure:

1. Those cases in which the vision of the amblyopic eye is materially improved by lenses.

2. Those in which the vision of each eye is nearly equal, and in all cases where there is absolutely no effect on the convergence from the prolonged use of atropin, I do not hesitate to advise an operation, always with a plain statement of the possible subsequent deviation. That this deduction is fairly correct is proved from a study of one hundred other cases occurring in the practice of Dr. Van Benschoten and in my own.

In no case where the amblyopic eye remained unimproved was there a successful result; while in the cases of alternating squint there was almost uniform correction of the deformity, and in the second class of the table 40 per cent. were successful and 30 per cent. partially so. There were 26 cases of paralysis of one or more of the extrinsic muscles which are not included in this table.

DISEASES OF THE LIDS.

Lupus.—Two cases of lupus of the eyelid have been under observation. In one the Roentgen ray was used, resulting in an extensive burn with great deformity and in no way affecting the ultimate result. In the other the "Finsen ray," so called, was used for thirty-two sittings. At first this treatment seemed to lessen the induration and heal the ulcerated surfaces, but the effect, if real, was but transitory and the disease steadily progressed. The remarkable results attained by Finsen can not, in my opinion, be duplicated by the man who has at his disposal only the commercial lamps to be obtained in this country which utilize but a moderate voltage. One case, not included in this series, has been under observation and without using either of these methods of treatment has remained quiescent and has not proceeded to the ulcerative stage.

DISEASES OF THE CONJUNCTIVA.

I regret that in these cases I am unable to give the bacteriologic findings in a sufficient number to make them of greater value, but I have used the silver salts often enough to warrant me in expressing a decided opinion on their relative value. There is, to my mind, no remedy which equals silver nitrate, no remedy that can be relied on in critical cases like this old-fashioned drug which has, in a measure, been superseded by newer synthetic compounds. Protargol I have discontinued because I have had marked argyrosis in several cases. Argyrol in 20 per cent. to 50 per cent. solution, if used frequently, has great value, but it is merely an adjuvant to the nitrate, and in a somewhat extensive hospital practice I have not been able to agree with Dr. Standish regarding its efficiency.

In 23 cases of ophthalmia neonatorum, in this series, 6 eyes were lost before I saw them; 3 were treated with argyrol alone, with corneal ulceration in 2; protargol was used in the treatment of 2, with no corneal affections, and 15 were treated with a solution of argentic nitrate, with one resulting scar.

The law compelling midwives to report all cases of inflamed eyes in the newborn has been on the statute books of Rhode Island for more than twelve years. There has been in that time no arrest or prosecution for violation of the law, but the publicity gained by its enactment has, nevertheless, been of great value, for the frequency of cases of ophthalmia has certainly been lessened by a half in the last decade.

DIONIN IN TRACHOMA AND PANNUS.

The remarkable and almost uniform improvement, which has followed the use of dionin and cupric sulphate in trachoma with pannus, is one of the few positive results I have attained with any of the newer drugs.

The various operations of curettage, grattage and scarification have been tried only to be abandoned, while reliance has been placed on the topical application of copper sulphate. Since the advent of dionin I have used it in the powder form, followed in a few minutes by the copper salt, with the result that the pain is lessened and the subsequent discomfort diminished and the cornea has cleared in a way I have never before experienced in my treatment of these cases. Either one used alone has not the effect of the two combined. Dr. Van Beneschoten has in his cases used dionin with a solution of mercuric bichlorid, and with the same success, so it is possible that I have ascribed too much to the cupric sulphate, but it is the combination apparently which is efficacious.

DISEASES OF THE CORNEA.

Edema of the cornea is a rare condition and is not even mentioned in many text-books. I have read of but one case in medical literature, and I have seen the following: An infant, two days after instrumental delivery and still showing across the lids and forehead the imprint of the blades of the forceps, presented a slight haziness of the cornea which rapidly increased till the whole anterior chamber was of a milky, white color. When first seen by me it had the appearance of an anterior dislocation of an opaque lens into the chamber. There was no reflex, no increased tension, no ciliary injection, and I was unable to see the iris in any portion. I considered the case to be one of traumatic dislocation, and it was a week later that beginning absorption of the cloud showed that there had been an infiltrate into the stroma of the cornea which cleared exactly as the infantile lens is sometimes absorbed after a discission, allowing me to see the exudate between the limiting membranes of the cornea, the entirely normal and active iris and clear pupil. In two months the cornea was quite transparent.

CORNEAL ULCERATION.

In the treatment of ulcers of the cornea, the usual methods prevailed and with the usual number of maculæ. One drug, however, once exploited but now forgotten by many, has proved of such service in all suppurative forms of keratitis that I have continued its use for fifteen years. Pyoktanin (yellow), although, according to bacteriologists, of weak germicidal activity, in my hands has been of great service. In one-half to 1 per cent. solutions, so dropped into the eye that it trickles slowly over the cornea, it has prevented the loss of tissue which insures a leukomatous condition, has relieved pain and hastened the healing process. In two cases of infection following extraction, this was my main reliance and the fortunate healing with a clear cornea was ascribed to its virtues. In sclerosing keratitis, its use with atropin and dionin has taught me that we can almost promise the patient a complete recovery in from two to three months. In these cases I do not deny the superior value of dionin, but in this series I have seen eleven cases of this disease, and where the three drugs were used the duration of the disease was lessened by some weeks. In maculæ of the cornea of recent origin the use of subconjunctival injections of a physiologic saline solution and powdered dionin yielded in a few cases brilliant results.

DISEASES OF THE SCLERA.

One of the most troublesome diseases I have been called on to treat is scleritis, for without a definite knowledge of its etiology our treatment is necessarily symptomatic. Eleven of the standard text-boooks agree on rheumatism as a cause; five mention gout, five scrofula, six ascribe the disease to syphilis and a like number to the irritation produced by light, wind and dust, while four say that menstrual disorders are a factor. In 16 cases of well-marked migratory scleritis I have been able to get a history of rheumatism in all but one; of syphilis not at all; in most of them there has been a general disturbance of health in greater or less degree, but, aside from the rheumatic or gouty diathesis, no uniform etiologic factor. A recent statement that a large proportion of patients suffering from scleritis show a distinct reaction to the tuberculin test may be of future value, but I have not had my attention called to the possibility of tuberculosis by any other presenting symptoms.

The treatment has been at all times devoted to the lithemic state, in spite of the claims that there is no such condition, and the local use of either atropin or pilocarpin. There seems to be no way of telling which drug will prove most efficacious save by trial. The protracted course of the disease and its frequent recurrence indicates the necessity for more careful study and consideration on our part. In a small proportion of the cases, pilocarpin proved an effectual remedy, but in over half of them a secondary iritis necessitated the use of atropin before the conclusion of the attack. Argyrol was used in several without effect. Ice and heat were alike inefficient. Adrenalin was of service only in temporarily blanching the parts and subcutaneous injections of pilocarpin muriate did not have material effect.

DISEASES OF THE RETINA.

Seventy-one cases of retinal disease came under my observation in this series and are classified as follows:

Hemorrhagic retinitis	11 cases.
Albuminuric retinitis	30 cases.
Albuminuric retinitis of pregnancy	3 cases.
Diabetic retinitis	6 cases.
Specific retinitis	2 cases.
Retinitis pigmentosa	5 cases.
Neuro-retinitis	4 cases.
Chorio-retinitis	3 cases.
Embolism of central artery	2 cases.
Unclassified	3 cases.
	71 cases.

Under hemorrhagic retinitis are grouped those cases of retinal apoplexy which, when first seen, did not necessarily present evidence of an active inflammatory process, but in my experience the diminution of vision has been quite as great in one as in the other. They were associated with arteriosclerosis, cardiac disease, leucocythemia, anemia and gout and in all the treatment was directed to the existing general condition with the exhibition of atropin, mercuric bichlorid or potassium, iodid and the avoidance of irritation by light or use of the eyes. There were 4 cases of complete recovery without scotomata and three cases of improvement: four remained absolutely unchanged. Of the 30 cases of albuminuric retinitis the subsequent history of 20 is known. Death occurred in all but one, and of these,

10 lived less than 3 months.
6 lived less than 6 months.
1 lived less than 12 months.
2 lived more than 2 years.
1 is living after 5 years.

In 16 of these cases the existence of a nephritis was not recognized or suspected till the ophthalmoscopic findings called attention to the condition, and in all the treatment was relegated to the family physician.

This probable length of life is entirely corroborated by a study of a much larger number of cases which I have previously reported. Seventy per cent. of these patients die within a few months. In the retinitis of pregnancy there was recovery in two, no improvement in one. In one case of retinitis, possibly specific, there was complete recovery, but with these exceptions there was no improvement in the condition or visual acuity in any of the cases I have seen. The apparent improvement of vision seen in some cases is, in my experience, apt to be due to faulty and inaccurate mensuration; reports by different observers of the visual acuity are not credible. The following case is unique in my experience:

Case 3.—E. G., aged 38, American, bank clerk, was first seen Jan. 23, 1903, when the vision was R. V. = 0.1 — 1.0 (—) 0.25 C. 180° = 1.0; L. V. = 0.1 — 1.25 = 1.0. Patient had specific disease of two years' duration and was under active treatment at the time. Two weeks previously a dentist, in killing a nerve, had broken a broach in the canal of the right upper canine tooth and had been obliged to extract the tooth after a fortnight owing to pain and inflammation. During the interval there had been a blurring of his vision in the right eye, which, however, lasted but a few hours, and at the first examination the vision with a correction for myopia was normal. Four days later there was an active serous retinitis with numerous hemorrhagic splashes over the entire upper half of the retina and the vision was reduced to the ability to count fingers at a few feet. More active specific medication was instituted, but the edema of the retina increased till there was an exudate springing from the retina at the macular region which extended into the vitreous and was freely movable, waving back and forth with each motion of the globe. February 17 the patient was seen by Dr. Hasket Derby of Boston, who gave as his opinion that it was either a metastatic condition from the trouble in the jaw or a reflex disturbance, he did not believe that it was specific in its origin. Mercurials and the iodids were continued, but without any effect and in June, 1903, the vision was but slightly improved, and there were numerous white atrophic patches where the hemorrhages had occurred and a slaty colored exudate nearly covering the site of the inflammation. There was no external evidence of inflammation, and the patient was allowed to return to work. Feb. 4, 1904, the vision was 2/50 and the same ophthalmoscopic picture presented. He was not seen again till April 21, 1906, when to my surprise I found that the vision had improved with — 1.25 to normal. The retina still presented the gray appearance, and there was visible the distinct white line of an obliterated artery, a branch of the superior temporal. The exudate into the vitreous was entirely absorbed. The vision has remained normal.

I have seen one other case where the placing of a crown on a canine tooth was followed by a hemorrhagic retinitis. In the absence of any other probable cause, the crown was removed and the root extracted. In the nerve canal was found a bit of steel one-eighth of an inch in length and a pus cavity was evacuated by the extraction. The hemorrhagic condition in the retina subsided in a month, with, however, no improvement in vision. These two cases tend to show a causal relation between the teeth and the retinal circulation which is not usually recognized in the text-books.

There were 13 cases of detachment of the retina and 9 were of recent origin. In the treatment I utilized, 1, rest in the recumbent position and pressure bandages; 2, pilocarpin as a collyrium and by subcutaneous injection; 3, scleral puncture; 4, subconjunctival injections of physiologic saline solution, and, 5, intraocular injection. In but one case was there a return of the retina to its normal position which was permanent and that was when a Graefe's knife had been passed through the sclera and retina at its most dependent portion. The resulting exudate has held the retina in position for more than twelve years.

EMBOLISM OF THE CENTRAL ARTERY.

In one case of embolism of the central artery, vision was restored.

CASE 4.—H. W., aged 55, American, one morning while dressing he placed his foot in a chair to lace the shoe and at that instant lost the sight of the right eye. I saw him a half hour later with the typical appearance of embolism and with the first temporal branch of the ascending artery collapsed and empty. Vision was *nil.* He was immediately placed in bed and an injection of pilocarpin given, repeated in twelve hours with a most profuse ptyalism and diaphoresis. Deep massage was instituted and kept up at intervals of a few hours. On the second day the ophthalmoscopic picture was the same, but while examining the fundus I saw the vessel fill with blood and a pink flush extend like a wave over the whitened area. There was immediate improvement in vision which some weeks later was nearly normal, a slight scotoma being the only trace of the accident. I ascribe the recovery of vision in this case to the fact that active treatment was instituted wihin a few hours after the accident.

With the exception of this case and possibly the specific retinitis reported above, I have not found any drug or any procedure which has materially influenced the condition. When the patient gets well he does so in spite of the treatment and not because of it, and the therapeutics of retinal disease is resolved into attention to the general condition—rest under atropin and avoidance of all irritation. As a rule, the patient does just as well if you tell him what is the matter and allow him to go his way as when active medication is instituted.

CONCLUSION.

In this series of 5,000 cases there have occurred many of great interest to me and from which I have learned useful lessons, yet I am not warranted in inflicting them on you, and I beg you will believe that what I have stated is not all that I have learned by experience. Indeed as the years go by I find that I rely more and more on the knowledge thus acquired in treating the commoner and often quite as troublesome diseases and depend on the current literature for the rarer conditions, even though to do so tends to keep a man in a narrower rut.

We can not all be teachers or pose as authorities, and I have little patience with the desire of many to acquire priority in the report of a case or the design of an instrument. Many of us are content to do, as best we may, the work which comes to us, availing ourselves of every proffered aid and seeking to increase the efficiency of our armamentarium and to eliminate the possibility of recurring mistakes. It is to these that I venture to plead for a more careful consideration of the commoner diseases that we are called on to treat rather than the devotion of time and energy to such cases as occur but once or twice in a lifetime. The field is wide and the last word has not been said in any of the topics I have mentioned.

THE VALUE OF TUBERCULIN TR AS A DIAGNOSTIC AND THERAPEUTIC AGENT

IN THE RECOGNITION AND TREATMENT OF TUBERCULOSIS OF THE EYE; WITH REPORT OF CASES.*

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Tuberculosis of the eye and its adnexa is a rather rare disease, though I believe not so uncommon as reported, for its presence is sometimes not recognized from lack of observation. We know that all parts of the eye may suffer secondarily from extension of the disease from lesions elsewhere in the body, yet it is a well-recognized fact that the ocular lesion may be primary, and the only existing focus of infection in the organism. It seems to be a well-established fact that tuberculosis attacks by preference the posterior segment of the eyeball, especially the more highly vascularized portion, like the chorioid, extending to the retina and thence by the blood vessels to the anterior segment of the eye. When the disease spreads from the interior to the exterior, the foci of disease may always be found at the filtration angle. The presence of indurated glands in anterior tuberculosis of the eye is not pathognomonic, but is of great diagnostic value, for statistics show that enlarged glands are found in about 85 per cent. of these cases. The microscopic examination of these glands does not necessarily render the diagnosis of tuberculosis certain, even if numerous giant cells are found, and the bacteriologic examination must prove the presence of the tubercle bacillus.

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DETERMINATION OF NATURE OF LESION.

To determine positively the tuberculous nature of an ocular lesion, we must apply three tests, viz.: 1, histologic; 2, experimental; 3, bacteriologic.

Histologic Test.—The respective value of these tests is well described by E. Treacher Collins,[1] who states that the reaction of the tissues to the tubercle bacillus consists of an aggregation of cells made up of a central giant cell, the so-called Langhans' cell, epithelioid cells, and marginal lymphocytes. These cell aggregations may undergo caseous degeneration or a general cicatricial fibrosis. These three conditions, the cellular aggregation, the giant-cell system and the caseous degeneration, found together in a tissue, make the diagnosis of tuberculosis practically certain; but the presence of any one of them alone is not sufficient proof.

The Experimental Test.—This consists in the inoculation of tuberculous tissue in the eyes of rabbits or guinea-pigs, and the most suitable situation is the anterior chamber. The tissue to be inoculated may be taken from any part of the organ, but must be entirely free from any suppurative organisms. The results of these inoculations of tuberculous material into the anterior chamber have been so generally successful that we have come to look on the experimental test as the most certain of all. The immediate reaction after such an inoculation is very slight. By the end of a week the piece of tissue has been absorbed, and the eye looks normal. After a period varying from ten to twenty days the iris becomes inflamed and shows small gray nodules scattered all over the surface, which grow larger, coalesce and sometimes fill the anterior chamber and invade the cornea. General infection of the animal soon follows.

The Bacteriologic Test.—The presence of the tubercle bacillus in the tissue is conclusive proof of its tuberculous nature, but failure to find the bacillus after the most careful search can not be regarded as disproving the tuberculous nature of a lesion. In some cases the bacilli are limited in number, notably in chronic cases.

MODE OF ENTRY OF BACILLUS IN EYE LESIONS.

The postmortem table has often taught us that many tuberculous lesions exist without giving any clinical

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[1] Ophthalmoscope, January, 1907.

evidence of their presence. We know that endogenous infection of the posterior segment of the eye occurs in acute dissemination tuberculosis, and also in connection with the chronic tuberculosis of the skin, bones and joints. But we occasionally see cases of tuberculosis of the eye, both intraocular and extraocular, without the slightest evidence of the disease in any other part of the organism at the time, though they may have developed later.

We are inclined to believe that, except through some perforating wound or loss of substance, the only other port of entry for the tubercle bacilli would be the lymphatic or blood circulation. But we have no positive evidence that the bacilli can enter the blood current, except by direct inoculation or the involvement of the blood vessel in a nodule of the disease. Hence the development of tuberculosis of the eye through the blood is always secondary to a tuberculous focus elsewhere.

We know that tubercle bacilli may pass through the mucous membrane of the bronchial tubes or of the intestinal tract and be absorbed by the lymphatics into the glands where they are arrested and infect these glands. In ocular tuberculosis there is frequently a history of tuberculosis in the family, and it is significant that the intraocular form of the disease is most common in children. It is probably certain that in all the intraocular tuberculous lesions the eye becomes infected by the blood current, and the bacilli would be most likely to be arrested and set up foci of disease at points where the finest vessels exist or at bifurcations of minute capillaries.

REAL NATURE OF TUBERCULOUS PROCESS.

The real nature of the tuberculous process in the body is still somewhat of a *terra incognita.* It seems probable that the tuberculous infection gives rise to multiple forms of intoxication, of which we as yet know little. The renewal of these various toxic processes occurs so constantly that our present means of investigation are insufficient to enable us to understand them, and for this reason the problem of tuberculous experimentation becomes very complicated. The tuberculous lesions develop slowly, especially in the posterior segment of the eye, whether the toxic product acts from a distance through the blood or from the presence of bacilli at the site of the lesion.

TUBERCULIN TREATMENT.

The tuberculin TR supplied by Merck is produced by triturating the dried cultures of the tubercle bacillus, digesting the resulting powder with distilled water and then rapidly rotating the solution by centrifugal force. After the centrifugal rotation has been carried on sufficiently long, the upper clear layer is poured off and the remainder further treated as before until complete solution is obtained. Then 20 per cent. glycerin is added. The solution then contains 0.1 c.cm. of solid matter in one centimeter.

The injections should be made, as a rule, every second day, beginning with a dose of 0.002 mg., and this dose should be gradually increased, but avoiding as far as possible febrile attacks.

There seems to be now no reasonable doubt that in tuberculin we have a valuable diagnostic agent. The diagnosis of tuberculous disease of the eye may be regarded as established in a given case, if the following conditions are noted: First, the undoubted constitutional reaction as shown in the typical sudden rise and fall of temperature, amounting to 2 or 2.5 degrees, accompanied by a chilly feeling and some pain in the joints; second, by repeated local reaction in the eyes, when the dose of tuberculin injected has reached the physiologic limit, as shown by marked increase in the ciliary injection and in the swelling and vascularity of the tuberculous nodules in the parts involved; third, if there be a hitherto unsuspected focus of disease in the bronchi or lungs, there will be a regular afternoon rise of temperature and a slight cough.

It is wise to begin with the smallest possible dose, in view of a possible profound general reaction. A failure to obtain a general and local reaction after one injection is not at all conclusive, but it should be thoroughly understood in advance that the diagnosis of the real tuberculous nature of a lesion can only be made when the rise in temperature is accompanied by distinct local reaction in the eye; but it can not be claimed that even this is positively conclusive.

The manner in which the injection of tuberculin TR proves of benefit or effects a cure is still somewhat obscure. It might seem from certain clinical observations that tuberculin does not directly cure, but merely retards, or arrests, or improves the tuberculous lesion. The production of antituberculin in the body can not be very great, for small amounts of tuberculin injected after weeks or even months in a given case will induce the typical reaction. Hence the immunity induced by an injection of tuberculin is merely relative, limited both quantitatively and as to time. The tuberculin seems sometimes actually to cause the diseased process to assume an acute course, and thus render the healing possible. It is rare that any beneficial effect from the injection of tuberculin is noticed before the lapse of two or three weeks from the first injection.

Before beginning the treatment it is well to begin taking the temperature of the patient three or four days before the first injection. Beginning with a dose of 0.002 mg., the strength of the injection may be gradually increased to 0.5 c.cg.

In summarizing the reports of the numerous authors which have been published during the last five years, it would appear that even by the most enthusiastic advocates of this method of treatment much less can be claimed for the value of tuberculin as a therapeutic agent than for its value as an aid to diagnosis, especially in cases of intraocular tuberculosis of the posterior segment of the eye. Tuberculosis of the chorioid and retina is apt to be of a chronic, non-virulent type and with a more or less pronounced tendency to spontaneous healing. These cases can undoubtedly be helped by tuberculin, though the disease may not be cured. Experiments with animal inoculation would seem to prove that the relatively favorable course of this chorioidal tuberculosis is due to the infection having been transmitted through the blood vessels, while the introduction into the eye of tuberculous material from without always causes a virulent inflammation.

My own cases here reported were all from my private practice and were all cases involving the lids or the conjunctiva, cornea and iris. I have not used tuberculin injection in any case of tuberculosis of the chorioid or retina. Of the ten cases reported, four were tuberculosis of the eyelid, one or both; three were cases of tuberculosis of the conjunctiva, which involved the episcleral tissue and the sclera secondarily; one was tuberculosis of the cornea, and two were tuberculosis of the iris. In both the latter cases the cornea and ciliary body were involved. In the observation and continued treatment of these cases I have come to the same conclusions as von Hippel.[2] It is all important to continue the injections for a somewhat lengthy period, several months, in order to prevent the occurrence of relapses. They must be continued until all nodules have been replaced by cicatricial tissue, all ulcerations are healed, until the swelling and vascularity of the iris have disappeared, and until all deposits on the posterior surface of the cornea and all opacities in the vitreous have been absorbed. In some cases the treatment, with occasional interruptions, must last five or six months.

By this treatment the tubercle bacilli are not killed, but the tuberculin TR excites a reactive inflammation in the surrounding tissue, in which scar tissue is formed. This should be the object of the treatment and is best obtained, as von Hippel states, by the use of small, gradually increasing doses of TR, which cause no apparent increase in the inflammatory symptoms. Relapses are frequent, but become less likely to occur if the treatment is carried out for months. I am not prepared to accept the very optimistic dictum of von Hippel, that "this remedy, properly handled and employed for months, will cure the severest cases of ocular tuberculosis with maintenance of vision." But I believe that it is a remedy of considerable value, and that in small doses, properly employed, it will not act unfavorably on the general health. By this method, in the course of two or three weeks, the ciliary injection diminishes, the deep corneal opacities begin to clear up, the nodules in the iris grow smaller and less vascular. In the course of the second or third month the ciliary injection disappears, the cornea becomes transparent or nearly so, the nodules disappear from the lids, the sclera or the iris, and a gray cicatricial tissue takes their place. The vitreous opacities last much longer, and may never entirely disappear.

Case 1.—Tuberculosis of left upper lid, including the conjunctival surface.

Patient.—A young woman, aged 29, was first seen in October, 1900, and gave the following history: About three months previously a small nodule appeared on the edge of the left upper lid in the outer-third. It resembled a stye and at first gave no trouble. It soon began to spread in both directions, but was not ulcerated. The patient was apparently in good health, but gave a history of some obstinate intestinal trouble three years before. Two cases of pulmonary tuberculosis in the family, a sister and a maternal uncle, with fatal termination.

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[2] Archiv. f. Ophth., lix, 1.

Examination.—When I saw her, the lesion involved the outer two-thirds of the lid, and extended well toward the upper margin of the tarsus. The margin of the lid was ulcerated and the ulceration extended upward on the inner surface of the lid for about 4 mm. The ocular conjunctiva and cornea were normal. The surface of the ulceration was pale and granular. The pre-auricular gland was swollen, and so were three of the upper cervical glands. Interior of the eye was normal, and vision was unaffected. The clinical picture was one of tarsitis.

Treatment and Result.—The ulcerated surface was curetted and the fragments removed showed under the microscope giant cells and lymphocytes, but no bacilli. The first injection of the minimum dose of T.R. gave the typical general reaction, but it was not until the third injection that any local reaction occurred in the eye and then it was decided by considerable swelling of the lid, injection of the conjunctival vessels, and increased secretion from ulcerated surface, and more marked swelling of pre-auricular gland. This patient received injections on alternate days for three weeks, and afterward two injections weekly for two months longer, and then one injection weekly for two months and a half. The dose was gradually increased from 2 mg. to 0.5 cg., which was the largest dose given. In all, the patient received forty-one injections, and the treatment extended over a period of five and a half months. There was no demonstrable effect until after the ninth injection, when the ulcerated surface began to clear up and the whole tarsus became softer. These changes continued until the lid could be everted easily and the ulcerated surface began to heal. At the end of the third month the edge of the lid and the conjunctival surface showed a smooth cicatricial appearance, and the lid had regained its normal thickness and appearance, except for a small node at the external canthus. About the middle of the fourth month the appearance was normal and swollen glands had disappeared. There has been no return of the disease.

CASE 2.—Tuberculosis of cornea and conjunctiva.

Patient.—A girl, aged 15, first seen in December, 1902, gave a clear tuberculous history on the paternal side for three generations. One brother died in infancy with some intestinal trouble.

History.—The patient had always been frail and anemic but had no pulmonary or intestinal symptoms. One year before I saw her the right eye became inflamed and she was told that the eye was ulcerated. After some months the inflammation subsided, but one month ago there was a relapse.

Examination.—When I saw her there was a dense, deep infiltration of the cornea in the inferior segment, occupying about one-third of the corneal diameter, and in the ocular conjunctiva were a number of small nodules. In the cornea were three small grayish-yellow foci, and there were a number of new-formed vessels running from the periphery toward the foci. The iris and pupil seemed normal, but the ciliary injection was marked. The pre-auricular gland was enlarged and sensitive to the touch, but there were no enlarged cervical glands. A careful examination of the lungs revealed no evidence of tuberculosis, and the gastrointestinal tract seemed normal as to its functions.

Treatment and Result.—The first injection of the minimum dose of tuberculin TR gave a pronounced typical reaction in the rise and fall of temperature, but no local reaction. The second injection, two days later, was followed within three hours by very decided reaction in the eye, the ciliary injection and all the clinical symptoms being made much worse, and this local reaction continued for more than a week. This patient received two injections a week for twenty successive weeks, and subsequently one injection weekly for five weeks longer, the total number of injections being forty-five, and the dose was gradually increased to the maximum of half a centigram. Improvement began after the fifth week, the ciliary injection becoming less marked, the miliary nodules in the adjacent conjunctiva becoming flatter, and the vessels in the cornea fading out. After the tenth injection the pre-auricular gland began to soften and in the course of two weeks the enlargement disappeared. After the fourth month all the ocular symptoms had subsided, except a small, somewhat dense opacity of the cornea near the lower margin, and this still remained when I last saw the patient, three years after the treatment was stopped.

CASE 3.—Tuberculosis of conjunctiva and sclera.

Patient.—A girl, aged 15, was first seen in March, 1903. There was no tuberculosis in the immediate family, but there had been in preceding generations.

History.—She had had ophthalmia neonatorum, but recovered with transparent corneæ. At the age of 12 I had fitted her with compound astigmatic glasses, on account of eyeache and headache. In January, 1903, she had a severe and prolonged attack of what appeared to be catarrhal conjunctivitis, but I did not see her, as she was at boarding school. From this the right eye recovered eventually, but the left eye showed a swelling on the temporal side of the eyeball, for which she was brought to me.

Examination.—I found an irregular fan-shaped thickening of the conjunctiva on the temporal aspect of the left eye, beginning at the external canthus, but stopping short of the corneal margin. About the center of this swelling could be felt and seen a distinct thickening and elevation of the sclerotic, but no ulceration. The pre-auricular gland and two cervical glands were enlarged.

Treatment and Result.—The first injection of tuberculin caused neither general nor local reaction. The second was followed by well-marked general reaction, but there was no local reaction until after the fifth injection, and this was only moderate. The patient was under treatment for five months and received in all fifty-four injections. Improvement began in the fourth week and advanced very slowly until at the end of the fifth month all the symptoms had subsided, leaving a somewhat discolored patch where the scleral infiltration had been located. There has been no return of the ocular lesion.

CASE 4.—Tuberculosis of the iris.

Patient.—A girl, aged 12, was brought to me in April, 1903, with the following history:

History.—She had had what was probably double iritis during an attack of inflammatory rheumatism six months before; the iritis lasted nearly two months, but finally cleared up and vision was restored to the normal. One week before I saw her the mother noticed a peculiar appearance in the right eye.

Examination.—I found in the infero-temporal quadrant of the iris a yellowish-red nodule, the size of a large pea, extending from periphery to ciliary margin, filling the angle of the anterior chamber and pressing against the cornea, and several smaller nodules in other parts of the iris. There was considerable ciliary injection and some pain. Syphilis could be absolutely excluded, and the diagnosis was between sarcoma and tuberculosis, with the odds in favor of the latter, as there was tuberculosis in the family, and the growths were multiple. The cornea over the tumor was striated. The rest of the media were clear, and the tension was normal. The pre-auricular gland was enlarged.

Treatment and Result.—This was the first case of tuberculosis of the iris in which I had an opportunity to try the treatment by tuberculin. The first injection produced very active general reaction, which lasted for nearly an entire day, and a decided local reaction in the eye, in which the nodule seemed to swell. Tuberculin was injected three times a week for ten consecutive weeks, and then once a week for four weeks longer, the patient receiving in all thirty-four injections. A noticeable improvement began at the end of the third week, the first symptom to disappear being the ciliary injection. At the end of the fourth week the smaller miliary nodules seemed to melt away, and the larger tumor began to contract. At the end of the tenth week this large tumor had all gone, the iris was discolored, but not perceptibly thinned, and the pupil could be dilated *ad maximum.* I saw this patient eighteen months later, and there had been no return of the growth.

CASE 5.—Tuberculous tarsitis of lower lid.

Patient.—A boy, aged 4, was first seen in April, 1904. His father died of pulmonary tuberculosis. The child had been well until three years old, when his mother noticed a swelling at the outer corner of the right lower lid. It was painless and there was no injection of the vessels or secretion. The swelling slowly increased without any other symptoms until one month before I saw him, when it became sensitive and a thin discharge appeared.

Examination.—When I saw him the outer four-fifths of the lid were involved, the tumor reaching the lachrymal punctum and involving the whole diameter of the lid from ciliary margin to near the orbital margin. On everting the lid, three points of ulceration were seen on the surface of the conjunctiva; one was rather large, but all were shallow and the base covered with miliary nodules. The pre-auricular gland and several cervical glands were enlarged and hard. The boy's general condition was bad. There were no evidences of pulmonary complication, but the bowels were very loose and he complained of abdominal pains.

Treatment and Result.—The first injection of the minimum dose caused pronounced general reaction and the second dose caused an increase in the swelling of the lid and in the amount of secretion. The general reaction was so severe that after the first week only one injection was given each week for four weeks. At this time the whole lid began to soften, the conjunctiva became less swollen, the sensitiveness disappeared, and the ulcerated surface began to clear. The boy was under constant treatment for five months, and received thirty-nine injections, the maximum dose being 0.012 mg. At the end of the fourth month the symptoms had all practically disappeared, but the treatment was continued for a month longer, as the patient's general condition was very much improved. There has been no return of the ocular disease, but the boy evidently has intestinal tuberculosis.

CASE 6.—Tuberculosis of all four eyelids.

Patient.—A little girl, aged 5, was first seen in July, 1905.

History.—The mother and maternal grandmother died of pulmonary tuberculosis, in spite of all that the possession of great wealth might do to prevent a fatal termination. The patient had always been frail, had a faulty digestion, and was of an excitable, highly nervous temperament. Two months before I saw her, a small lump appeared in each upper lid, and subsequently several others developed in both lids.

Examination.—When I saw her there were two small nodules in the right upper lid, one in the right lower lid, looking exactly like small chalazion. The whole of the left upper lid, the external canthus and the outer-third of the left lower lid were hard and swollen, but there was no ulceration of either skin or mucous surface. The pre-auricular gland and all the cervical glands on the left side were involved. The eyeballs were intact. Congenital syphilis could be positively excluded. A careful examination of the child revealed no other foci of disease. The urinalysis was normal, but the blood count showed a marked diminution in the number of the red-blood cells.

Treatment and Result.—The first injection gave a decided general reaction and also a local reaction, the ocular conjunctiva becoming injected and edematous. The injections were given twice a week for twenty weeks. There was no sign of improvment till the end of the third week and then the lids of the left eye began to soften and the swelling diminished. At the end of the sixth week the nodules in the lid of the right eye had disapeared. By the end of the fourth month the upper and lower lids of the left eye had regained their normal dimensions and mobility, though the upper lid was still somewhat stiff. The child's environment had been of the best and she passed most of the day in the open air, and her general condition had greatly improved. She took forty injections, the maximum dose being 0.2 mg. The child has been under observation ever since and there has been no return of the lesion.

CASE 7.—Tuberculosis of conjunctiva and episclera.

Patient.—A little girl, aged 5, was first seen in January, 1905.

History.—No tuberculosis existed in the immediate family, but there were several cases in collateral relatives. The child was small for her age, but in excellent health. The disease began about a year before I saw her in persistent redness of the ocular conjunctiva, in the supero-temporal quadrant of the right eye, which in the course of a few weeks was followed by a series of small, miliary nodules. There was no pain, and at first no secretion. The redness and thickening of the conjunctiva gradually extended inward, outward, and downward, until when I saw her, it involved the entire temporal half of the ocular conjunctiva, and extended almost to the corneal margin.

Examination.—The whole tissue was much thickened and elevated, and presented a number of small nodules of a reddish-yellow color. A careful examination of the child did not reveal any other foci of disease. Media were clear and fundus was normal. The pre-auricular gland was enlarged, but there was no hypertrophy of the cervical glands. A portion of thickened tissue was removed for microscopic examination, but though numerous giant cells were found, there were no bacilli. A small piece was inserted into the anterior chamber of a rabbit, but caused nothing but a slight reaction which soon subsided.

Treatment and Result.—The first injection of tuberculin caused the typical general reaction, and the fourth a rather violent local reaction in the eye, with marked increase of the redness and swelling. This child received an injection twice a week for six weeks. Then owing to an attack of tonsillitis the treatment was discontinued for ten days. It was then recommenced and two injections were given each week for ten successive weeks. I could not discover any improvement until after the third week. Then the nodules seemed to flatten, coalesce and become merged with the general thickening of the conjunctiva, and the vascularity began to diminish. At the end of the third month the swelling had all gone, but the vascularity still persisted for another month. The child received in all thirty-two injections, beginning with the minimum dose and gradually increasing it to the maximum 0.5 mg. I saw the patient recently and there was no return of the lesion.

CASE 8.—Tuberculosis of the iris.

Patient.—A young man, aged 23, was first seen in September, 1905.

History.—He came of a tuberculous family on the paternal side, but his boyhood and youth had been healthy. For more than a year he had been treated for some obscure intestinal trouble, and also for an obstinate hypertrophic rhinitis. Two months before I saw him there appeared slight redness of the right eye on the nasal side, which persisted, and later the iris was discolored.

Examination.—When I saw him there was marked ciliary injection inward and downward, the inner half of the iris was discolored, there were posterior synechiæ, and in the inferonasal quadrant was a yellowish-red nodule, as large as a pea, attached to the periphery of the iris by a broad base, and filling the angle of the anterior chamber. In the upper segment of the iris were two smaller nodules, projecting into the anterior chamber. The pupil could only be dilated upward and outward. The vision proved to be only 15/200, and the ophthalmoscope showed a few yellowish red patches of exudation in the chorioid, all recent. These were not exactly like chorioidal tubercles, recently developed, though free from pigmentary deposits, but taken in connection with the nodules in the iris, their appearance was suspicious.

Treatment and Result.—The first injection of tuberculin gave both a general and local reaction, and the latter lasted for nearly a week, and was doubtless kept up by the following injections. This patient was under continuous treatment for about four months and received in all forty-six injections. An improvement was noticed after the third week, but the symptoms disappeared very slowly and it was not until three months and a half had elapsed that the eye regained its normal external appearance. The adhesions of the iris were all broken, and the iris regained its mobility and round pupil. The chorioidal patches flattened and faded, but did not disappear. Vision was eventually improved to 15/30. The other eye remained intact, and the general health of the patient was improved.

CASE 9.—Tuberculosis of conjunctiva and cornea.

Patient.—A young woman, aged 17, was first seen in October, 1905, with absolutely no tuberculous family history, and with the exception of an obstinate constipation, was in good health.

History.—Two months before I saw her the right eye became inflamed on the temporal side near the cornea, and there was some dull pain. The symptoms gradually grew worse, and when I saw her the ocular conjunctiva on the temporal side was very much thickened from the external canthus to the cornea.

Examination.—The appearance was that of an exaggerated pterygium with marked thickening of the conjunctiva and episcleral tissue spread out like an open fan, with the apex in the cornea. The latter was densely opaque in its lower half, and was ulcerated. The pre-auricular gland and the entire chain of cervical glands on the right side were enlarged. The upper part of the cornea was slightly hazy but the iris seemed normal, and the pupil reacted promptly. There was little or no secretion. A part of the thickened tissue was removed for examination, and showed numerous giant cells, but no bacilli. Inoculation experiments on a rabbit proved negative.

Treatment and Result.—The tuberculin TR injection gave promptly the general reaction, but it was not until the fourth injection that any decided local reaction in the eye occurred. This proved to be the most obstinate of all the cases in resisting treatment. She received three injections a week for twenty-two weeks, and after that two injections per week for three weeks longer, making in all seventy-two injections. At the end of the six months the redness and swelling of the conjunctiva had all subsided, but the cornea remained cloudy in its lower third. The haziness of the upper part of the cornea had disappeared and vision was much improved. The enlargement of the glands had subsided except in one of the lower cervical glands.

CASE 10.—Tuberculosis of conjunctiva and sclera.

Patient.—A boy, aged 14, was first seen in January, 1906

History.—There was no tuberculosis in the family. The boy was in good health, but had suffered from a mild form of granular conjunctivitis in both eyes for some months. The left eye had been cured, but two months before I saw him a swelling or thickening of the ocular conjunctiva in the right eye, on the nasal side, appeared.

Examination.—When I saw him, the ocular conjunctiva was densely infiltrated from the caruncle to the corneal margin and about midway between the two there was a broad nodule with distinct elevation, the surface of which was ulcerated. The ulcer was shallow, and when cleaned, showed a reddish granular surface. The pre-auricular gland was enlarged. The cornea was clear and the iris normal. Conjunctival, ciliary and scleral vessels were engorged. No evidence of any pulmonary or intestinal disease existed, and if the ocular lesion were tuberculous, the infection must have come from without, through some abraded conjunctival surface.

Treatment and Result.—The first injection of tuberculin proved negative, as did also the second. The third injection, however, still of the minimum dose, gave a marked general constitutional reaction, and a slight reaction in the eye. At the fourth injection the dose was increased and caused a rather alarming increase in the injection and swelling of the conjunctiva, so that cold applications became necessary for twenty-four hours. This excessive reaction never occurred again. This patient was treated for five months, receiving in all sixty-two injections, but was discharged not cured, though somewhat improved. The ulcerated surface healed, and the large nodule softened, flattened and finally disappeared, but the general thickening of the conjunctiva and sclera remained, though decidedly less marked than at first. The ciliary injection disappeared and the conjunctival vessels were reduced in caliber, but very little impression was made on the scleral congestion. This case proved rather discouraging in the results gained from the treatment.

THE RELATION OF THE CIRCUMLENTAL SPACE TO THE CAUSATION OF GLAUCOMA AS SHOWN BY THE WURDEMANN LAMP.*

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It is obvious that this disease is caused either by excessive secretion in the eye, or by obstruction in its outlets, or both.

Hippocrates applied the term glaucoma to all opacities behind the pupil. Taught by dissection, Brisseau[1] was the first to announce in 1709 that, while cataract was an opacity of the lens, glaucoma was a similar affection of the vitreous humor; therefore, no operation could afford relief. Mackenzie early in the last century recognized the disease as one of pressure, stating that:[2]

> **A morbid secretion, of the origin of which we can give no accurate account, fills the cavity of the retina, but, like other morbid productions, is not furnished with the apparatus of removal, necessary for keeping its quantity *in equilibrio*. Hence the unnatural firmness of the glaucomatous eye, a symptom that often increases to such a degree that the organ is felt to be of a stony hardness.**

Von Graefe believed the pressure was due to a chorioiditis with exudation. When the invention of the ophthalmoscope showed that the chorioid did not show any anatomic changes in this tissue he assumed that there was a serous exudation present. Donders ascribed the increased pressure to irritability of the ciliary nerves, causing excessive secretion from the chorioidal vessels. Stellwag believed the starting point of the disease to be an increased pressure in the intraocular blood vessels, obstructing the vortical veins where they make a sharp turn at their exit from the globe.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

[1] Mackenzie (William): Diseases of the Eye, 1833, 583.

[2] Ibid., 586.

In support of the exudation theory Beltman[3] recently reported a case of chronic glaucoma associated with an enormous telangiectasia of the face, and dilatation of the external blood vessels of the eye, narrowing of the field of vision, increased tension and pain. The glaucomatous pressure was most severe just before the menstrual period, when the blood pressure is known to be the greatest. He held that a corresponding dilatation of the chorioidal vessels increased the secretion of fluids in the eye.

In 1873 Leber[4] showed that the path of the aqueous humor is from the ciliary processes through the pupil to the spaces of Fontana, called the filtration angle of the eye. Three years later Knies and Weber[5] independently found closure of the filtration angle, and of the canal of Schlemm in most cases of chronic glaucoma. This discovery gave a great impetus to the retention theory. It should be noted that in most cases of acute glaucoma these outlets are unobstructed.

Ring[6] saw glaucoma lighted up by the instillation of euphthalmin solution into the eye. We are told not to use atropin, cocain or even adrenalin in solution where there is a tendency to glaucoma, through fear of compressing the filtration angle; but only recently I had a patient with acute glaucoma referred from a physician, who had used a solution of atropin for the intolerable pain, thinking he was dealing with a case of iritis. The pain soon subsided, vision was reduced to fingers, but gradually rose to 3/50. When an operation was suggested the patient dropped out.

Intraocular tumors produce secondary glaucoma by causing increased pressure in the vitreous, while posterior synechiæ, anterior staphyloma from injuries, dislocation of the lens, and serous cyclitis obstruct the outlets of the eye, the latter clogging the filtration angle with albuminous fluid.

Sala found an excess of albumin in the aqueous humor in two cases of contusion of the eyeball, followed by glaucoma.[7] Peters[8] corroborated this by citing four cases of glaucoma after contusion, with the aqueous loaded with albumin. He suggested that the traumatism caused paralysis of the ciliary body and consequently an increased secretion of albumin, impeding filtration.

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[3] Congenital Telangiectasia of the Eyes as a cause of Simple Glaucoma, Graefe's Arch. f. Ophth., lix, 502.

[4] von Graefe's Archiv. xix, No. 2, 87.

[5] Ibid., xxii, No. 3, 163, and xxiii, No. 1, 1.

[6] Glaucoma from Euphthalmin, Trans. Am. Ophthal. Soc., 1903.

Bartels[9] incised the conjunctiva in four or five places in rabbits and dogs, passing threads behind the muscles from one slit to the next and tying the threads. He produced a condition similar to acute glaucoma, injection of the conjunctiva, anesthetic cornea, wide pupils (except in rabbits), and increased tension. There was absence of obstruction in the filtration angle in all cases. He concluded that obstruction in the anterior ciliary venous circulation is the probable cause of glaucoma.

According to Priestley Smith,[10] the lens increases in diameter one-tenth and in volume one-third between the ages of 20 and 60. He holds that hyperopic eyes are most liable to the disease, for in these the lens develops out of proportion to the dimensions of the eye, pressing against the filtration angle. He claims also that a narrow cornea goes with a small eye; and in patients whose corneal diameter is not more than 10 mm., few escape the disease.

I examined the eyes of 200 persons of all ages to see to what extent the lens encroached on the ciliary processes as age advanced. I applied the Würdemann lamp to the margins of the lids at the outer canthus and looked obliquely through the pupil. When one eye is affected with glaucoma, the other may be examined by using alypin for a local anesthetic, as it does not increase the tension of the eye, but rather decreases it. If the observer looks forward far enough into the normal eye, he sees the ciliary body as a dark ring."[11]

The space between the rounded margin of the lens and the ciliary processes is given as 0.5 to 0.6 mm. The lens being about 9 mm. in diameter, if this diameter were increased one-tenth, it would come near to the ciliary processes; then any unusual congestion might cause trouble.

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[7] Glaucoma Following Discission and Contusions of the Eyeball, Klin. Monatsb. f. Augenh., April, 1904.

[8] Glaucoma After Contusions of the Eye and Its Treatment, Klin. Monatsb. f. Augenh., Dec., 1904.

[9] Ueber Blutgefässe des Auges bei Glaukom, und ueber experimentelles glaukom durch Versperrung von vorderen Abgeführenden Blutbahnen, Berlin, S. Karger, 95.

[10] Norris and Oliver's System, iii, 650.

[11] Würdemann (H. V.) : Ophth. Rec., November, 1906.

An eye affected by glaucoma has a narrow circumlental space, as a matter of course. It is also narrow in all cases in which, after middle age, the lens is pushed forward so far as to render the anterior chamber shallow. This condition is common with people who die of old age and who never had glaucoma. Since commencing this line of investigation. I have noticed many cases in which the anterior chamber was very shallow, and the circumlental space also, yet there was no increase of tension. I have noticed also that the members of a family in which glaucoma has appeared all have a narrow circumlental space. I have not seen a case of narrow cornea, all the cases of glaucoma that I have seen having corneas measuring 11.5 mm. Hyperopia is common, but some cases are emmetropes.

Priestley Smith, with scientific fairness, remarks,[12] "the obstruction at the outlet, discoverable in eyes blinded by glaucoma, explains the excess of pressure in the chambers, but it does not reveal the starting point of the disease." He describes an apparatus for injecting the eye,[13] consisting of two flexible tubes, each being provided with a pinch tap, and ending in hollow needles. These tubes are suspended at the same height. The eyes of a sheep are removed immediately after death and injected while they are still warm. One of the needles is inserted into the aqueous chamber, and the other into the vitreous chamber. The fluid in the tubes is a 1 per cent. solution of aniline black. When the tubes are at the same height, the fluid passes through the filtration angle, and flows from the cut ends of the episcleral veins. Now, if the tube connected with the vitreous chamber is elevated above the other, the process of filtration stops; the lens and iris advance, and there is no escape of fluid from the severed veins.

It would seem that chronic glaucoma must be caused by excessive pressure in the vitreous chamber, caused by diseased blood vessels in the uveal tract; at the same time there is probable alteration in the constitution of the aqueous humor, which blocks up the outlets. We have seen that this alteration in the fluids produces glaucoma after traumatism, and in serous cyclitis; and Troncoso claims to have found an excess of albumin in eyes affected by chronic glaucoma. Why may not the ciliary process secrete albumin when age has changed the character of the blood vessels?

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[12] Norris and Oliver's System, iii, 633.
[13] Ibid., 632.

If sympathectomy ever relieved the intraocular tension, it did it through its influence on the circulation in the chorioid and the ciliary processes. The same must be said of iridectomy. It does not reduce the tension immediately, showing that its influence is exerted on the intraocular circulation. Another thing pointing in the same direction is the fact that in some cases of iridochorioiditis with diminished tension, it is increased by an iridectomy.[14]

My thanks are due to Dr. Myles Standish, Dr. H. B. Chandler and their assistant, Dr. Clap, in the Eye and Ear Infirmary, for their courtesy in allowing me to examine their patients.

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[14] Berry (George) : **Diseases of the Eye, Art. Glaucoma.**

THE SURGICAL TREATMENT OF CHRONIC GLAUCOMA.*

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There is probably no form of ocular disease which has excited more interest or which affords, in some of its clinical features, more reasonable opportunity for opposing opinions than chronic glaucoma.

Although it is my purpose in this paper to discuss the surgical treatment of the disease, it is, first of all, important that we should entertain a common understanding of the clinical picture had in mind.

For a generation there has been no doubt in the minds of experienced surgeons as to the necessity and signal value of iridectomy in the treatment of the inflammatory types of glaucoma. But in so-called chronic, simple, or non-inflammatory glaucoma there has been much diversity of opinion as to the value of surgical interference.

It is probable that the adverse views which have been and are still entertained by different surgeons depend, in large measure, on the mental concept entertained by the individual surgeon of both the nature of the disease and the exact clinical picture had under consideration.

It can not be denied that there is room for doubt as to the exact nature of certain comparatively rare cases of ocular disease characterized by steadily increasing impairment of vision, a concentric narrowing of the field, and typical glaucomatous cupping of the optic nerve, but with entire absence of pain, inflammatory signs, demonstrable increase of tension in the globe or notable exacerbations in the clinical history. The progress in this group of cases is steadily onward toward blindness, much as in simple atrophy, unless it is possible by treatment to arrest its course.

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There is a wide reach between this picture of glaucoma simplex and, for example, the stormy manifestations of disease afforded by glaucoma fulminans, with its violent objective and subjective signs of inflammation, the stony hard ball and almost sudden abrogation of functioning power. Between these extremes, however, lies the large group of cases with which we are all familiar and which I believe to be those our chairman wishes me to discuss. A careful study of this group, however, will serve to show that at some time in their early history these patients have manifested the symptoms of disease so vaguely as to leave both patient and surgeon in doubt: The former as to whether anything is actually wrong with his eyes, whether he is not, after all, the victim of his imagination; the latter in doubt, certainly as to the nature, perhaps even of the existence, of a disease of which he now and again gets vague glimpses only, but which for many weeks or months, it may be, eludes his most subtle means of analysis and leaves his diagnosis suspended until such time as the cupping nerve, the contracting field, the increasing impairment of central vision shall have declared its nature. In a word, till the condition has passed from the stage of incipient glaucoma simplex into the stage of easily recognized chronic glaucoma.

The question for the surgeon to answer to his own satisfaction is: Does this subtle, but colorless, progressive malady belong in the same category with inflammatory glaucoma? The answer given to this inquiry will, in great measure, determine both the course and vigor of his advice and treatment.

Our unwillingness to answer it definitely in the affirmative is the cause of the vague and variable condition of the literature of chronic glaucoma and affords sufficient reason for the timid and vacillating treatment of the disease during its early stage. That the affirmative answer is too often, or too long, withheld in individual cases should not cause surprise. The indeterminate clinical history, in a relatively small group of cases, is maintained to the end; that is to say, until irretrievable blindness has resulted before the inflammatory stage of the disease is reached. Then, sooner or later, come the engorged long anterior ciliary vessels, the hard eyeball, the completely atrophic, deeply cupped nerve, and pain, with more or less well-pronounced inflammatory signs.

Fortunately, however, in many cases new and more determinate features are added to the clinical progress of the disease which prompt the timid surgeon to definite action before it is too late. These symptoms are generally slight, transient exacerbations of increased dimness of vision, with suggestion of discomfort or actual pain, accompanied with a sense of fulness in the eye and periorbital region supervene.

The patient may ascribe the symptoms to overfatigue after a hard day, to some error in diet, to overuse of the eyes or to dim or too bright light. After rest the acute symptoms disappear and may not recur for many weeks or even months, but the impression has been left on the mind of the patient that the eyes are not so good as they were before the attack of dimness. Recurrences, however, are sure to follow and they come with increasing frequency and variable severity. The recovery after each exacerbation is not so complete as at first. The impairment of vision soon becomes permanent even between the attacks, but worse during their continuance, and pain becomes a well-marked feature. Halos are observed around the gas flame or lamp, and the eyes are injected, it may be but slightly. The cornea is steamy, the tension of the ball is increased even between attacks, but is variable, being greater during the recurring more acute exacerbations at which time the sensibility of the cornea is diminished. If no treatment is instituted this history may be pursued for long periods of time, finally causing complete loss of vision with atrophy and characteristic cupping of the nerve. In other cases following on some unusual stress, as ill fortune, or some cause for grief, the scene closes with a sudden attack of glaucoma fulminans.

The dangers which cluster thickly about the clinical history of chronic glaucoma are greatly enhanced by this subtle beginning and the variable and treacherous course of the disease which has been briefly described. There is no form of ocular disease in which early recognition and well-defined views as to its nature and treatment are more important; for, if treatment is delayed until the delicate retinal fibers, where they emerge over the scleral ring, are injured too greatly by the recurring periods of increased tension of the globe, it is not to be expected that any procedure whatever can restore their function.

The greatest danger of delay on the part of the surgeon is in the group of patients in whom the disease progresses without obvious exacerbations; that is to say, in cases in which there has been demonstrable hardness of the ball or attacks of extraordinary dimness of sight. Here the inquiry may reasonably be made, Why operate, or, for that matter, why use miotics, in an eye in which increase of tension has never been observed. since both the miotics and iridectomy are employed with the ostensible design of reducing increased tension?

In reply it may be observed that increased tension of the eyeball is always relative. In the first place, it is probable that our mental concept of normal tension is an overestimate for many eyes. That is to say, for some eyes, e. g., those with a thin sclera, a degree of resistance to palpation which would be normal for many eyes is excessive and amounts to an increased hardness, sufficient, indeed, to account for the cupped nerve. For it is fair to assume that in the eye with a thin sclerotic coat there will be also a relatively too readily yielding lamina cribrosa.

Then, too, it is not only possible but it is rendered probable by certain clinical signs that mild exacerbations of increased tension coming on especially in the night often pass without recognition by the patient. Many persons ascribe their insomnia to ocular discomfort, and this symptom is frequently ameliorated by the use of weak solutions of eserin salicylate instilled at bedtime. The same drug will often relieve also the weak eyes and occipital pains with which many patients awake early in the morning.

There is, moreover, a rational basis for this, in some measure, *a priori* reasoning. The patient retires for sleep after the fatigues of the day and assumes a recumbent posture. The lights are extinguished and the pupils dilate, blocking the spaces of Fontana as effectually as though a mydriatic had been employed, thus furnishing conditions which delay excretion of the intraocular fluids and favor increase of tension in the globe.

That this deductive reasoning is based on a correct premise seems to find corroboration in the well-known frequency with which attacks of acute, inflammatory glaucoma come on in the night, during sleep, in patients with glaucoma imminens. We are justified, therefore, in assuming that in cases of marked cupping of the nerve without any increase of tension ever having been observed, that it had nevertheless occurred, possibly in the night or during sleep, an inference which finds additional force in the observed clinical fact of the well-known relation, under all ordinary circumstances, between the cupped nerve, contracted field of vision and increased tension of the ball.

It is believed that the suggestions in the preceding pages will find corroboration in the following clinical histories of carefully observed cases occurring in my private practice, in all of which opportunity was afforded for continuous observation for long periods of time. After careful consideration this course was chosen in preference to carefully applied statistical tables of large numbers of both private and clinic patients, in many of which the clinical history was incomplete.

Case 1.—Chronic Glaucoma in Right Eye. Iridectomy, followed by Creeping Non-inflammatory Glaucoma in the left, Culminating in an Attack of Acute Inflammatory Glaucoma and Permanent loss of Vision.

Patient.—Mrs. M., aged 50, was sent to me by her physician in 1879 for failing vision in the right eye. She had been treated several months for recurring right hemicrania, which had been regarded by her physician as the cause of the pain and loss of sight in the right eye. The eyeball was hard, pupil dilated, cornea slightly hazy, and lacking in sensibility. Vision was reduced to one-fourth or less, 20/lxxx, and the field to a small area in the temple side. The nerve was deeply cupped and atrophic. The left eye was aparently normal in all respects. V. = 20/xx.

Operation.—A broad upward iridectomy was performed on the right eye which gave rapid and complete relief from pain, and vision rose to 20/lxiv, with normal tension of the globe and some improvement in the field.

Postoperative History.—There was no recurrence of the glaucoma and vision was maintained for two years, then slowly sank through atrophy of the optic nerve until total blindness was reached in 1884, five years after her first consultation. In October, 1883, she was alarmed over a spell of dim sight in the left eye while at her dressing table preparing for an evening entertainment, and she came to see me the following morning. The impaired vision lasted less than ten minutes, she thought, but she then related that the trouble in her right eye began in the same manner several years before I had seen her, and was repeated at varying intervals until it had culminated in the "neuralgic" attacks in the eye, which both she and her physician believed were caused by the hemicrania; she declared that she now knew better, and begged that something be done to arrest the disease in the left eye.

Treatment.—The vision was 20/xx; there was no contraction of the field and tension was normal. She received eserin solution to be used in the event of another attack, which unfortunately followed the first in a few weeks, coming on in the evening again after a fatiguing day in the shops. These attacks continued to occur at long but varying intervals for a year and a half, but were relieved in a few moments by the instillation of the eserin solution, which she kept constantly at hand. The exacerbations occurred invariably in the evening, but had always disappeared before she could get to my office for study, so that up to this time I had not seen her during an attack.

April 10, 1884: V. = 20/xx, and there was but little if any variation from the normal in the field of vision, but there was a quite obvious cupping of the nerve at the lower border. The lower temporal portion of the nerve was gray. She was then told of the undoubted character of the disease and that it would surely pursue a similar history to that of the right eye, and was urged to consider the necessity for operation in the near future. The fate of the neglected right eye, so far from convincing her of the wisdom of early interference, as it should have done, had the directly opposite effect on her mind.

Jan. 24, 1889: I did not see her again until this date, nearly five years later. In the meantime, however, she had continued to use the eserin solution with increasing frequency on her own responsibility, until its daily use had become a constant habit. She had, as a result, a chronic granular conjunctivitis. V. = 20/xl. The field of vision was contracted, nearly concentrically, to about 30° on the perimeter chart, with an additional cut in the lower nasal field. The cornea was clear, the pupil reacted, but somewhat sluggishly, to light and shade and contracted under a miotic. The anterior chamber was shallow, tension doubtfully +1. The nucleus of the lens was gray and ophthalmoscopic examination difficult. Operation was then strongly urged but declined. She received a stronger solution of eserin salicylate to be used twice daily. Under this vision rose to 20/xxx and the field was broader.

May 22, 1889: Her visits had been discontinued for the previous five months, but the miotic was continued. Vision remained at 20/xxx, and there was no notable change in the field, notwithstanding the fact that she had many attcks of transient impairment of vision, which she observed were apparently precipitated by eating fruits, especially peaches or grapes. She again declined to submit to iridectomy, and did

not return until November, 1889, the miotic having been steadily employed. In the meantime her husband had suffered financial ruin and died. Her vision had sunk to 1/10, the pupil was habitually dilated, but contracted under a strong solution of eserin; the field was so much contracted that she found difficulty in going about without an attendant, the lower half of the field of vision being entirely absent. The dilated pupil permitted a study of the nerve, which was now deeply cupped. She was having moderate pain. The ball was rigid but not very hard.

Nov. 28, 1889: While using the eserin solution three times daily she suffered a violent attack of acute inflammatory glaucoma, which came on in the night. The following morning the ball was stony hard; there was no perception of light. She was suffering intense pain and begged for immediate operation, which was performed under general anesthesia in the afternoon after a cautious paracentesis in the morning. On the third day she had conjunctival inflammation with chemosis, which subsided under treatment. The pain and tension were entirely relieved, the wound healed kindly, but convalescence was tedious. Vision slowly returned.

Feb. 2, 1891: Fourteen months after iridectomy, V. = 20/cxxvi. The lower field was blind, even for candle flame. Two months later vision was only 2/cc, eccentric fixation, and sank rapidly to total blindness. She lived about two years subject to the most distressing visual hallucinations.

This unfortunate history can not be contemplated without sadness. There can be but little doubt, in the light of many other experiences, that blindness would have been prevented in both eyes of this patient had a skillful iridectomy been performed in each during the early stage of the disease. In the first eye the glaucoma was cured by the operation, but too late to avert blindness by progressive atrophy of the optic nerve. In the second eye she would not submit to operation until too late.

The history, however, seems to show the danger and futility of relying with too great confidence, certainly in all cases, on the sufficiency of miotics in averting the fatal denouement.

The following history of a patient who came under observation during the same years as the previous case seems to justify the conclusions just formulated.

Case 2.—Chronic Glaucoma, Exacerbations of Subacute Inflammatory Glaucoma, Following Many Years of Recurring Attacks of Dim Vision without Pain or Redness of the Eye.

Patient.—Mrs. T., aged 40, consulted me in November, 1887, with chronic glaucoma. She related that she had consulted two eminent colleagues, the first in 1875, the second in 1876, both of whom had advised iridectomy, to which she had not submitted. Her vision had been failing steadily for a long time before consulting them, but she had frequent attacks of dim sight, lasting at times for a few minutes only, but often for several hours. These attacks had not been acompanied by pain or redness until 1878. The tension was, in the right eye, + 1. V. = 20/lxx. The pupil showed a tendency to dilate, there was a well-marked glaucomatous cup and an intermittent pulsation of the lower temporal retinal artery. Left eye, V. = q. p. l. T. + 2, pupil dilated, deep glaucomatous cup and retinal pulse. Some ciliary injection and pain.

Operation.—Iridectomy was performed under general anesthesia in both eyes, with an interval of one week. The symptoms were entirely relieved, the fields of vision improved in both eyes and vision had improved on July 10, 1879, eight months after the operation, in O. D., with correcting glasses, to 20/lxiv; in O. S. to 20/cc. Eleven years later vision in the right eye was 20/xxx, but in the left there was nearly complete blindness, with a total atrophy of the nerve. In October, 1906, I saw this patient, then 68 years of age, alight from a railroad train and pursue her way unattended, evidently seeing her way about with ease.

CASE 3.—Non-inflammatory Glaucoma in both Eyes, Progressive Loss of Vision and Contraction of Field, Deep Glaucomatous Cupping of Both Nerves. No History of Exacerbations; Constant Headache; Iridectomy in Both Eyes at One Sitting.

Patient.—Mary F., aged 24, a mulatto, came to see me in 1878 because of rapidly failing vision and constant headache. There had been no inflammatory symptoms at any time and no exacerbations of ocular disturbance, with the sole exception of increased pain in the head from time to time, which radiated from the eyes and periorbital region to occiput, often keeping her awake at night. The failure of vision had been rapid until she at last found difficulty in doing work about the house. She stumbled over chairs, knocked things over on table and mantelpiece, etc. This proved to be due to marked contraction of the field of vision, which at no point was wider than 40°, and was only 10° in the upper and lower fields of each eye. Central vision was 20/xl in each, and tension was normal. Both optic nerves were gray, devoid of capillaries and deeply cupped.

Operation.—She was admitted to the Episcopal Hospital and a broad upward iridectomy performed on both eyes at the same sitting, under general anesthesia, on June 7, 1878. The convalescence was uneventful, and on July 23, 1878, with correcting glasses, central vision remained at 20/xl, but the field was wider.

Postoperative History.—This patient was kept under observation for many years. She married and gave birth to several healthy children. She was last seen at the Wills Eye Hospital, March 16, 1894, sixteen years after the iridectomies were performed. She still had high grade of astigmatism in both eyes, but with careful correction O. D. V. = 6/vi, O. S. V. = 6/ix, miscalling confusion letters with each eye. The field of vision in the right eye, temple 76°, nasal 10°, lower temple 55°, lower nasal quadrant blind, upper temple 40°. In the left eye, temple field 76°, lower and upper temple quadrants 40°, upper nasal 10°, lower nasal 50°.

This patient, who at 24 years of age presented all the classical signs of advancing glaucoma simplex, i. e., absence of increased tension or inflammation, but with characteristically cupped nerves and contracted fields, sixteen years later was found with a permanent improvement in both central and peripheral vision and without any advance in the atrophy of the nerves.

Case 4.—Myopic Astigmatism.

Patient.—Mrs. McC., aged 30, was referred to me by Dr. George M. Gould in June, 1897. She had for many months been using eserin under Dr. Gould's advice.

History.—There was a deep glaucomatous cup in both nerves and marked contraction of the field of vision in the right eye, to 30° in the temple and lower, 20° above and to 10° in the nasal field. The increase of tension was apparently slight, but the balls were large and the sclera thin. There was a broad, atrophic, myopic conus at the temporal side of both optic nerves. In the right eye, with correcting glass V. = 20/c (1/5). The left eye had only quantitative perception of light, T. = + 1. She was suffering from violent periorbital and occipital headaches, was extremely nervous and hysterical, and was a victim of vaginismus, which had been the cause of much domestic discord. There had never been inflammatory symptoms or exacerbations of ocular disturbance.

Operation.—She was admitted to the Wills Eye Hospital and a broad, peripheral iridectomy was performed on both eyes. The periorbital and occipital pain promptly disappeared and the field of vision in the right eye markedly improved in all directions. The left eye resumed normal tension and was free from pain, but remained blind.

Postoperative History.—Nine years later this patient returned with an acute conjunctivitis. There had been no return of glaucoma, and the acuity of central vision remained as in 1897, so that she was able to earn a living for herself and three children as a music teacher.

It is interesting to note that, after the relief from her simple glaucoma by operation, her general neurotic condition had greatly improved and she had given birth to three children.

It is obvious that the iridectomy had saved the right eye from the fateful denouement of the simple glaucoma which had befallen the left under the steady use of the miotics alone.

CASE 5.—Chronic Non-inflammatory Glaucoma, Entire Absence of Pain or Tension. Iridectomy in Both Eyes.

Patient.—Mrs. K., aged 77, a tall, spare, swarthy woman with stalwart frame, was brought to me in March, 1895, by Dr. S. W. Wiley, of Norristown, Pa., complaining only of her failing vision, supposing it to be due to cataract. The vision had not been good for many years, but failure had been more rapid during the last year.

Examination.—O. D. H. = 3.D., with correcting glass. V. = 1/lx, and nasal field cut to fixation point, temple 50°, 30° above and below. The pupil reacted sluggishly, the tension was doubtfully increased, but the eyeball was rigid. The media were clear. The nerve was greenish and deeply cupped to its scleral border, except at the nasal side, where the vessels emerged in a peculiar manner from the apex of a deep physiologic excavation. There was a slow, occasional pulse wave in the lower temporal artery. In O. S. with her correcting glass + 4 D. V. = 6/xviii. Field cut to near the fixation point on nasal side, but temple field nearly normal. T. = + ? Pupil reacted to light and contracted under eserin promptly. The nerve was cupped as in O. D., but was obviously less atrophic. Iridectomy was advised in both eyes as the only means of arresting the disease, but an unfavorable prognosis was given. She received a solution of eserin to be used as freely as possible without causing pain, and returned to her home in the center of the state. She returned after two weeks with marked improvement in central vision in both eyes, but a more pronounced cut in the lower field of each.

Operation.—A broad peripheral iridectomy was performed on the left eye and six days later on the right. Recovery was rapid in each and uneventful.

Postoperative History.—April 18, 1895: The tension was subnormal in both eyes. In O. D. vision had risen to 6/lx, and the field of vision for form had widened to nearly normal, except an area of blindness even for candle flame, which included almost the exact lower nasal quadrant. In the left eye the temporal field was nearly normal, but the entire nasal field was blind to candle flame. With + 3.00 s ⌒ +3.00 cy ax 165° V. = 6/xii.

May, 1895, a month later: V. in O. S. same, but in O. D. V. had risen to 6/xviii.

November, 1895, six months later: Vision in the right eye had slowly fallen again to 6/xlviii, with a concentric narrowing of the remaining field.

Oct. 10, 1898: The optic atrophy had steadily progressed in the right eye to nearly total blindness, approximately three and a half years after the operation, but at no time had there been any increase of tension or other renewed signs of glaucoma.

The left eye, however, in which the onset of the disease was more recent and the cupping of the nerve and atrophy less advanced, retained vision 6/xxiv, with no further change in the fields until the patient's death on Aug. 9, 1900. More than five years after the iridectomy.

There can be no reasonable doubt that had the iridectomy been performed at an earlier date this patient would have been spared blindness from atrophy in the right eye also. Had the operation been done before the serious impairment of the fields of vision in both eyes I am convinced that she would have enjoyed throughout the remainder of her life approximately normal vision.

This conclusion would seem to find adequate corroboration in the history of the following patient, referred to me for operation by a colleague. Incidentally this case is introduced to represent a large group of patients operated on in private practice within the last ten years, seven of them within the last two years, in all of whom useful vision had been destroyed in one eye when first seen and the disease was already passing into the inflammatory stage, while in the other eye the disease was still in its incipiency. In all of them glaucoma has been completely arrested in the second eye by operation, and at the present date without exception they enjoy approximately normal vision. The fate of the blind eye, furthermore, illustrates the danger of deferring operation even under the steady and judicious employment of a miotic.

CASE 6.—Chronic Glaucoma.

Patient.—Mrs. J., aged 60, consulted me Feb. 21, 1906. She had been using eserin under close observation for more than two years. Notwithstanding this, she had suffered exacerbations of dim sight from time to time, but no severe pain. Her vision in October, 1904, was in O. D. 20/xxx, in O. S. 20/xv.

Examination.—When seen by me it had sunk in O. D. to 10/cc. eccentric fixation. In O. S. to 20/xxx. O. D. T. = + 2, pupil dilated, A. C. shallow, media transparent, deep cupping, nerve atrophic, and marked pulse in both upper and lower temporal arteries. The sensibility of the cornea was impaired and only a small island remained in the temporal field near the fixation point. There was severe pain. O. S. V. = 6/ix, T. = N (+ ?), ball had a rigid sclera, pupil reacted to light, A. C.

was shallow; there was a beginning cup at the lower border of the nerve, no retinal pulse, and no marked impairment of field.

Operation.—She was admitted to the Wills Eye Hospital and a broad peripheral iridectomy was performed on the right eye on Feb. 26, 1906. The convalescence was uneventful. The pain and tension were promptly relieved and she was discharged from the hospital on March 7, with no improvement in the field.

Subsequent History.—She was readmitted to the hospital and on March 19, 1906, iridectomy was performed on the left eye. Convalescence was normal till March 21, when she had a sudden pain, probably from injury during sleep. The following morning the anterior chamber was filled with blood. This was rapidly absorbed and recovery progressed without further incident. On May 18, 1906, two months after operation, with + .25 s $\overset{\frown}{\smile}$ + 1.25 cy. ax. 170° V. = 6/v, and the field of vision was normal in all respects.

March 23, 1907, one year later: O. D. V. = only q. p. l., optic nerve atrophic. O. S. + 1.25 cy. ax. 170° V. = 6/v. T. = N. in each eye. Eyes are white and free from pain.

CASE 7.—Simple Glaucoma.

Patient.—I. L., aged 41, consulted me May 28, 1898, with simple glaucoma. At that time the right eye was apparently normal with V. = 6/vi and no restriction of the field. In the left eye vision was reduced to 6/xv and a marked cut in the nasal field, the upper nasal quadrant being cut to almost fixation point. The anterior perforating vessels were full and tortuous. There was an arterial pulse in both upper and lower temporal arteries and a well-marked glaucomatous cup.

Operation.—Iridectomy was advised and performed on the left eye May 30, 1898. The operation was smooth and recovery without incident.

Subsequent History.—This patient was kept under observation at short intervals until September, 1899, at which time there was a distinct cupping of the right optic nerve and a progressive narrowing of the field of vision, but worse in the upper nasal quadrant. In a word, the eye was obviously pursuing the same history as the left had done before the operation. Vision in the left eye had risen to 6/x, and the field of vision was markedly improved in all directions except the upper nasal quadrant, which remained unchanged. Iridectomy was then advised for the right eye also, but declined. Nothing more was heard from this patient until during the preparation of this paper, when the vision in the left eye was found unchanged, but the right eye, on which she had rejected the advised operation, was totally blind.

This brief history of Case 7 is introduced to give the reverse of the picture as set forth in Case 6. Here the operation on the left eye had been accepted early enough in its history to save the vision, whereas the right eye, which was not operated on and which was the better when first seen, had been allowed to take its course uninterruptedly to the end.

The case histories which have been introduced are selected simply for illustration and to demonstrate the claim which has been made in the introductory remarks, viz., that the clinical history of glaucoma simplex, chronic or non-inflammatory glaucoma, when followed from the incipiency of the disease during long periods of time, demonstrates that the affection belongs, in its essential character, in the same category with glaucoma fulminans, or acute inflammatory glaucoma; that the latter violent manifestation of disease is in fact but the denouement of the former. In a word, the symptom complex we have recognized as glaucoma imminens is a steadily advancing simple glaucoma, which, under the stress and strain of life, and the pathologic changes in the organism which come on and advance between the forty-fifth and sixty-fifth years of age in large numbers of people, under favoring ocular conditions culminate in the types of disease under discussion.

It is true that in a considerable number of individuals the culmination into acute inflammatory disease, for many reasons, may never come, but may, nevertheless, end in total blindness, beginning and ending as a purely local manifestation of disease. But add to the local affection some general dyscrasia—notably the rheumatic or gouty diathesis with the accompanying disease of the general vascular tree and the associated impairment of the general nutrition—and it is easy to conceive how the participation of the ocular tissues, notably the uveal tract, in the general pathologic state, may furnish local mechanical and pathologic conditions which culminate in the inflammatory types of glaucoma and their striking symptoms-complex. Blindness already reached as the result of simple glaucoma does not, however, necessarily avert the occurrence of acute glaucoma. Every surgeon must have found it necessary to do iridectomy or to remove the offending eye for the relief of pain in blind eyes with absolute glaucoma, it may have been many years after total loss of vision had been suffered.

The technic of iridectomy is important. There is probably no more difficult surgical procedure than iridectomy in the acute stage of inflammatory glaucoma.

I am of the opinion that it should never be attempted except under profound general anesthesia. The hard eyeball, the steamy cornea, the shallow anterior chamber, the engorged, often inflamed iris, not infrequently form a group of conditions which make its correct and safe performance extremely difficult. The frequent failure to arrest the disease by the operation under these difficult conditions is, I am sure, because it has been found impossible to carry out an ideal technic. These difficulties in the acute inflammatory stage furnish a strong reason for operation before the occurrence of glaucoma fulminans, not only for the purpose of averting this catastrophy in patients under observation, but for the sufficient reason that in the non-inflammatory stage of the disease the operation can be performed with ease, precision and safety.

In no other operation on the eye is a faultless technic of more signal importance than in iridectomy for glaucoma if we hope to arrest the disease. This is always possible so long as we have an anterior chamber of approximately normal depth, a reacting iris and a patient quiet under general anesthesia.

I believe that, for a successful issue, the iridectomy should be peripheral, i. e., to the root of the iris, and that it should include one-sixth of its circumference.

I very much prefer the triangular bent keratome, the blade of which is approximately an equilateral triangle, the base and the cutting sides being equal. The blade should be entered through the corneal limbus at a point as nearly as possible on the same plane with the anterior surface of the root of the iris and carried forward parallel with it until the base of the knife engages in the wound. The slow and deliberate withdrawal of the knife is important, as it allows the gradual escape of the aqueous, prevents the sudden impact of the lens against the cornea, and often avoids the prolapse of the iris into the wound. The iris forceps can then be made to seize the iris at a selected point near the rim of the pupil, when it should be gently but firmly drawn out and carried strongly to one angle of the wound. The tension outward being steadily maintained, it can be severed at its base by successive snips with the scissors as the remaining uncut portion is carried toward the opposite angle of the wound. The severance being complete, the anterior chamber is apt to fill with blood; the angles of the wound, however, should be carefully freed from any entanglement of the pillars of the coloboma and the blood be allowed to escape by gentle but firm pressure made on the posterior lip of the wound by the flat side of an elastic tortoise shell spatula. If it is found impossible to free the anterior chamber of blood by this means no other effort should be made. The blood will usually be absorbed in from twelve to twenty-four hours and its presence is much less to be feared than the results of manipulation to secure its escape. It is probable that opacities of the capsule and lens cortex are more frequently caused by the efforts of the surgeon to free the anterior chamber from blood than from any direct injury to the lens by the point of the knife or by the forceps in grasping the iris.

In my experience the occurrence of cataract after iridectomy has been very rare except in cases in which the opacification of the lens had already begun before the operation. In one case of acute glaucoma with a very hard ball, a sudden escape of aqueous before the section was completed thrust the lens violently forward against the knife, rupturing the brittle anterior capsule and opacity followed, but in this case general anesthesia was prevented by the general condition of the patient.

TREATMENT OF ULCERS OF THE CORNEA.*

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This paper is limited to treatment of ulcers of the cornea, but to indicate intelligently the proper procedures which one must use in treating this ever varying symptom it is necessary to have as a basis some classification of the pathologic process, for the treatment must vary according to the conditions. In other words, no hard and fast lines can be laid down for the handling of ulcerations of the cornea *per se.*

If we consider the subject from the standpoint of development then we have to treat ulcers of the cornea on the ground that they are either primary or secondary, and if secondary the cause is of first consideration in the line of treatment. The treatment, too, is modified, as the ulcer may be marginal or central, superficial or deep, simple or infected, progressive or regressive. Then, also, we may have to approach the subject from the symptomatic standpoint and possibly this may be the best way to approach it. Some symptoms are common to all forms or classifications of corneal ulcers, and not infrequently the trouble has to be treated entirely according to the symptoms: Pain, photophobia, impairment of vision, pericorneal injection, loss of corneal tissue and sometimes iritis.

For pain and photophobia in acute stages a solution of the sulphate of atropin is useful, from 1 to 4 grains to the ounce of distilled water; two drops are instilled in the conjunctival sac from once every three hours to three times a day; a saturated solution of boric acid is also useful as a lotion, and a pair of plain or toric dark glasses may be needed. In sthenic cases leeches may be applied to the temple in addition to the preceding treatment. Solutions of cocain for pain and photophobia give immediate relief, but do more harm than good if used at all continuously. If conjunctivitis coexists the lids may be touched up with a solution of nitrate of silver, from 2 to 5 grains to the ounce. In the subacute and torpid stages, or when acute symptoms do not exist, stimulation should be practiced, and this is accomplished by the use of the yellow oxid of mercury ointment, combined with atropin, or by itself in the later stages when atropin is not needed. At this stage powdered calomel, iodoform or thymoliodid (aristol) may be sprinkled on the ulcer instead of using the mercurial ointment. A solution of the sulphate of eserin, instead of atropin, is frequently used when the ulcer is small and sluggish.

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In deep and sloughing ulcers atropin is almost universally used because of its quieting effect and because it lessens the chances of iritis, but frequently eserin is the better remedy, because it has a tendency to stop the migration of white corpuscles and promotes absorption, through dilitation of the ciliary vessels, at the same time lessening tension. It is particularly indicated in marginal ulcers in strengths of from gr. 1/4 to 1 grain to the ounce of distilled water, one or two drops of this solution being instilled into the eye at intervals of from four to eight hours; but on account of its tendency to promote ciliary congestion and iritic irritation, a solution of the sulphate of atropin in strengths of from gr. 1/2 to 4 grains to the ounce of water, two drops, once daily, should be used to overcome this tendency. Dionin (ethyl-morphin hydrochlorid), combined with the atropin or eserin, in strengths varying from 1 to 10 per cent., has been used to aid these drugs in allaying pain and promoting absorption.

When perforation is impending antiseptic compresses should be used continuously, except when making the local applications or when suppurative conjunctivitis exists. If the floor of the ulcer bulges a paracentesis should be performed, followed by application of eserin or atropin, depending on the location of the ulcer. Paracentesis may have to be repeated several times in order to relieve pain and to hasten recovery.

Spread of local infection may be stopped or retarded by scraping with a curette, by the application of chemicals or by the use of the cautery. After curetting away all the sloughed material it is well to touch up the ulcer with a solution of corrosive sublimate, 1-2000, and to dust on iodoform or other antiseptic powder. Cauterization is indicated in all sloughing ulcers when other measures have not been efficacious, and in infecting ulcers of the serpigenous type.

Bandages are used either for protection or pressure; for protection they are applied to keep the lids closed and to keep the ball quiet and to keep out dust and light, but they are contraindicated if there is much secretion.

We must also take into account the general health of the individual affected, the locality in which he lives and his age. There is nearly always a lowered vitality with a corneal ulcer, and by use of constitutional measures corneal resistance is increased. A calomel purge should be given to rid the system of bacteria and their ptomains. The system should be toned up with fair doses of quinin, which increases the phagocytic action of the cells and reinforces the resisting power of the cornea. If we would have our treatment in all particulars a success none of these considerations may be neglected. Definite rules may not be laid down, but certain principles are common to the various types.

The cause must be removed in order that the symptoms may be speedily arrested. It is not always possible to locate or to designate the cause of a given ulceration, but when due to the presence of a foreign body in the conjunctival sac or on the cornea itself, the irritation must be effectively removed. When ulceration is due to misplaced or misdirected cilia, these should be removed by electrolysis in order that they may not again be objects of irritation. When a chronic catarrhal conjunctivitis, or an acute contagious conjunctivitis, or a trachomatous condition coexists with an ulceration of the cornea, any one of them should receive our first consideration when blocking out our line of treatment, for while they may not be the direct cause, they are always aggravating factors. Chronic catarrhal conjunctivitis may require several changes in treatment before it is conquered, as the conjunctiva soon becomes accustomed to or wears out one line of treatment. If the secretion be considerable a solution of nitrate of silver, from 1 to 10 per cent., may be used to touch up the membrane of the conjunctiva, or a solution of from 0.25 to 0.5 per cent. may be dropped into the conjunctival sac, to be followed by a thorough washing of the conjunctiva with a boric acid or normal salt solution. Of late years many prefer a solution of argyrol (silver vitellin) varying in strength from 10 to 50 per cent.; this drug has the advantage of being much less painful than nitrate of silver, but has the disadvantage of being exceedingly mussy. Sulphate of zinc is another favorite remedy in solutions varying in strength from 1 to 5 grains to the ounce of water. The alum stick applied to the mucous membrane of the lids may be used at times with great advantage. With all of these, solutions of boracic acid are used for cleansing and antiseptic purposes.

If we have phlyctenular conjunctivitis to deal with it is not infrequently connected with a phlyctenular keratitis, and here the general health must be treated, as well as the local conditions, if we desire the best results, and an ulceration is the essential pathologic condition. The patient should be built up on iron and the ulcer stimulated.

Acute contagious conjunctivitis, when due to the gonococcus, is very likely to have ulceration of the cornea as a sequel. Solutions of nitrate of silver have been the standby to prevent and remedy this complication. Later solutions of protargol (protein silver salt) were used and lauded by many operators; and, later still, argyrol (silver vitellin) has had its many enthusiastic users. One of the most recent aspirants for favor in these infective ulcers is dessicated yeast. It is freshly prepared for each application, which may be anywhere from every hour to once or twice daily. The desiccated yeast crystals are mixed with distilled water until they are thoroughly dissolved, making a creamy solution, which is put into the conjunctival sac with a dropper or rubbed into the ulcer with a cotton-tipped applicator. This remedy is useful, not only in gonorrheal infections of the conjunctiva, but in many other conditions characterized by considerable secretion.

Having removed the cause, one should endeavor to prevent the spread of the ulcer, that perforation, with its diastrous consequences, may not take place; or that opacity of the cornea may not be so extensive as materially to impair the vision. Probably this extension may be best prevented by the use of mercurial ointment, the yellow oxid being the favorite, in strengths varying from ¼ to 1 grain, thoroughly mixed with one dram of lanolin or petrolatum, with directions to use a piece one-half the size of a kernel of rice within the conjunctival sac and thoroughly distributed by massage once or twice every twenty-four hours. If the ulcer shows a pertinacious activity, it may be scraped with a corneal spud, or touched up very carefully with the pure tincture of iodin, anhydrous carbolic acid or the galvanocautery.

A simple central ulcer, by neglect or through poor nutrition, may develop into a purulent or deep ulcer. If the ulcer be centrally located, it ought to be treated with a solution of the sulphate of atropin in strength of from 1 to 4 grains to the ounce; but the treatment for peripheral ulceration would the more likely be productive of good if a solution of sulphate of eserin in strength of from ½ to 2 grains to the ounce were used, especially if the ulceration is very deep, because it lessens tension.

As pain has a tendency to increase tension, it may be combated by intermittent moist heat. Cloths wrung out of hot water and placed on the eye for from ten to thirty minutes, every hour or two, will ordinarily make the patient comfortable, but poultices should never be used. The moist heat not only diminishes the pain, but it allays the congestion, develops blood vessels, and by increasing nutrition hastens the process of repair. Nothing in the way of medication which may leave metallic deposits on or in the cornea should be used, and all collyria should be soothing. When perforation is threatening, myotics should be used or paracentesis performed and this may be repeated every twenty-four or forty-eight hours, if necessary.

Should the necrotic process be marked, subconjunctival injections of bichlorid of mercury may be used in strength varying from 0.1 to 1 per cent., depending on the extent of the necrosis.

Secondi uses as a subconjunctival injection, when such conditions exist, a solution composed of one part of bichlorid of mercury, two parts chlorid of sodium, 2,000 parts of water, injecting anywhere from a few drops to half a dram.

Darier injects a few droys of a 1-4000 solution of the cyanid of mercury. These measures should be preceded by instillation of a few drops of a cocain or holocain hydrochlorid (ethenyl-paradiethoxy-diphenyl-amidine hydrochlorid) solution in the conjunctival sac, as the injections are painful and are liable, by reason of their irritating qualities, to produce a necrosis of the conjunctiva. A normal salt solution seems to be just as efficient a subconjunctival injection, without the necrotic tendencies. If, under these lines of treatment, the ulcer continues to spread or to grow deeper, cauterization is indicated, and this may be accomplished either by drugs or cautery. A 50 per cent. solution of the nitrate of silver, tincture of iodin or pure carbolic acid are the drugs most commonly used. They may be applied to the ulcer by means of a small piece of cotton wound on a wooden toothpick, using only enough of the drug to cover the ulcer. The actual cautery or the galvanocautery is useful and sometimes most essential, but should be used only by the expert and on patients not exceedingly nervous, except in desperate conditions. A 10 per cent. solution of nitric acid, applied with the cotton-tipped toothpick, is exceedingly efficacious in serpiginous ulcers, and when this fails a Saemisch incision may save an otherwise almost hopeless eye. In severe ulcerations, due to diplobacilli, Paul recommends Peters' zinc-ichthyol salve.

Chronic serpiginous or Moren's ulcers have always been prognosticated unfavorably, in the light of the results of ordinary treatment, on account of the tediousness of the disease and its tendency to relapse, but it would appear, from the reports of Paul and Romer, that the prognosis has become vastly better by the introduction into the treatment of Romer's pneumococcus serum. One c.c. of the serum is injected into the subconjunctival tissue at the first treatment and one-half the amount on every other day. It is not so painful as the cyanid of mercury.

The process of repair is promoted by all the measures mentioned. The moist heat favors the separation of necrotic tissue, promotes development of blood vessels in the cornea and relieves pain. Paracentesis through the base of the ulcer or outside of it, when perforation is threatening, does good by relieving tension and starting the flow of lymph, thus promoting repair.

If perforation and prolapse of the iris occur early, the patient should be anesthetized, the iris drawn out and cut off, the spatula being used afterward to tuck back into place the angles of the iris coloboma. Sometimes a piece of conjunctiva, twice the size of the original opening, is tucked between the edges of the corneal wound and secured by a compress bandage. This results in a flat scar externally and an anterior synechia internally.

All ulcers leave behind them opacities of greater or less density, which last for short or long periods of time, depending on their character. These need stimulation, which may be accomplished by the various mercurial unguents, the favorite of which has already been mentioned, if only a mild stimulant be needed. Calomel in powdered form, sprinkled on the cornea very lightly, once in twenty-four hours, gives a more active stimulation, while jequerity, in powdered form or in watery solution, will set up an acute inflammation, which results in a marked clearing of the cornea, where blood vessels have been the chief cause of the opacity.

Galvanic electricity has also been used for the removal of corneal opacities. A silver-cupped cathode, with a drop of mercury on it, is placed on the cornea, while the sponge anode is placed on the cheek, and a current of from one-quarter to four milliamperes is turned on for a period of from one to five minutes, every three or four days. Massage by a facial artist or expert masseur may be of much value. This may be direct to the cornea itself or indirectly through the lids from one to three times daily. Massage is assisted very materially by the use of hot packs.

The internal treatment of opacities must not be overlooked, especially in patients concerning whom it can not be said, as it was of Caesar's wife, that they are above suspicion. In such, saturated solution of the iodid of potassium, in gradually increasing doses, running from 5 grains three times daily to 60 or 70 grains three times in the twenty-four hours. will work wonders, and in many cases in which we are unable to find any specific history or symptoms this drug will frequently give very decidedly happy results.

Another drug, concerning which much favorable mention has been made as a scar remover, is thiosinamin (allyl sulphocarbamid), but with what confidence one may praise its selective power on the cornea it is a little unwise to say. It is used internally in from two to three grain capsules, two or three times daily for two or three months, or by hypodermatic injections into the skin of the back in solutions of varying strengths, daily or every two or three days, over a period of five or six months. That it does have a very marked effect on the scar tissue, softening it and causing it to disappear to a great degree in patients on whom no other treatment is being directed, there can be no doubt, but in many patients it seems to affect the scar tissue not at all, and as yet no rules have been formulated to differentiate or to determine beforehand the patients to whom it will be beneficial.

Thus far the treatment has been directed at the opacity itself, locally or through the general system, to the end that vision might not be interfered with. Having failed in clearing up any given opacity of the cornea, which interferes with the vision, if there be any peripheral cornea transparent, vision may be secured by an iridectomy or an iridotomy. There are many cases in which everything has been done which is possible for vision, but in which the opacity is central and unsightly. This may be removed, or at least for a limited period, by needling with or without India ink or by keratoplasty.

As Theobald says, there is a vast difference in the behavior and in the intractability of corneal ulcers. In some instances, they are uncontrollable and tend to go from bad to worse, in spite of all that can be done to combat them, and this probably depends on the nature of the bacteria producing the ulceration and the feebleness of the opposition.

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TREATMENT OF PURULENT OPHTHALMIA.

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By purulent ophthalmia we usually understand that form of conjunctivitis characterized by a flow of pus and due to gonococcic infection, and from this standpoint I will discuss this question. The forms of purulent conjunctivitis of gonococcic origin, which are the most common, are ophthalmia neonatorum, the purulent ophthalmia of the adult, and a third form, quite rare in some localities, namely, the purulent conjunctivitis of young boys and girls.

PROPHYLAXIS.

As "an ounce of prevention is worth a pound of cure," I shall presume that we are apprised of the possibility of infection in any given case, either remotely or immediately, and hence shall refer to the prevention, if possible, in any such given case. Prophylaxis in ophthalmia neonatorum is so well known and thoroughly established that simple reference to this important procedure at once suggests Crèdé's method, introduced in his practice in the Lying-in Hospital of Leipzig in 1880, whereby the percentage of cases was reduced from 10.8 per cent. to 0.1 or 0.2 per cent. This record is sufficient to commend the practice where even the remotest possibility of infection exists, as well as to condemn the failure to resort to it.

In the case of all individuals who are suffering from a specific urethritis great stress should be laid on absolute cleanliness of hands, linen, towels and utensils, and in

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some, if not in all cases, segregation should be required. In addition, the patient must be impressed with the importance of these measures, as they relate to the infection of the eye. In the case of young girls or boys who are exposed to infection from a known existing source they should be separated as far as possible from that source. If they themselves are the subjects of infection other than about the eye then their parents or responsible attendants should be warned and all necessary precautions taken to prevent this complication.

TREATMENT.

But presuming that the period for prophylaxis has passed and infection has occurred, several questions at once present themselves for consideration. The first is that of cleansing and keeping the eye free from secretions. The primary object of this procedure is to free the eye of pus, which is rapidly formed; this is most important, and for this purpose many solutions have been suggested and used. As boric acid is always at hand and its solutions are not dangerous in the hands of average attendants, I usually resort to a saturated solution of this agent, though when cleaning the eye myself I frequently use a solution of bichlorid of mercury, 1:10,000. Artificial aids to irrigation I have not used, but rather depend on the ordinary method of cotton pledgets dipped in the irrigating solution and squeezed into the eye. As to frequency of cleansing, it should be resorted to as often as is necessary to keep the eye free from pus. This varies from every few minutes to every hour or two, according to the case, the stage of the inflammatory process or amount of pus being produced.

COLD APPLICATIONS.

In the early stages of the attack the use of local applications of cold has been advocated by some and condemned by others. Touching this measure, I may say that it may give relief to symptoms and perhaps be used with safety in cases of robust adults where the cornea is not involved, but in infants or young children difficult to manage I do not use it. The chief danger in cold is that if it is applied to the point of efficiency as to temperature and length of time it is apt to reduce the nutrition in the cornea to a point where ulceration is set up and the condition seriously complicated. In view of these dangers from the use of cold it should be used, when used at all, to combat the pain by relieving the congestion, and then only for a few minutes (five to ten) at a time, with long intervals between the applications. Even in hospitals where house surgeons and trained nurses of experience are charged with its use it should be resorted to tentatively only, but in the general run of private practice it is a two-edged sword as a routine procedure.

SURGICAL TREATMENT.

Surgical procedures are resorted to by some in the conduct of these cases, such as the scarification of the chemotic ring about the cornea, or if the cornea is threatened by the pressure of the swollen and tense lids, a canthotomy, or even the vertical splitting of the upper lid. As to the first procedure, the time and the frequency of resorting to this must depend on the judgment of the physician. As to canthotomy, it should be done only when the pressure symptoms are severe and prolonged; fortunately this is not often; as to the vertical splitting of the upper lid, I think it is rarely necessary, and then in extreme cases only. In this connection I think I am justified in saying that in the great majority of cases, if early seen and vigorously treated, the necessity for surgical interference is reduced to the minimum, and fortunately so, for we thus avoid making a port of entry for the invader.

Last, but not least, we should resort to Buller's shield in all cases of infection of one eye only. A word concerning this protective measure may be said at this point. Before applying the shield the eye should be thoroughly cleaned and disinfected with a solution of *protargol,* twenty to thirty grains to an ounce of water, and the shield so applied that it will be open at the outer and lower angle so as to provide proper ventilation, which prevents the clouding of the lens by moisture from the eye. The watch glass used should be as large as convenient and clear so the eye is at all times easily inspected.

MEDICINAL TREATMENT.

Now as to active treatment looking to the combating of the actual pus-producing agent. If I have reason to believe from the history of the case that the infection is due to the gonococcus, even though the pus has not made its appearance, I make it a rule to begin at once the active treatment of the condition, taking no chances, for I believe that much good can be accomplished at this time. I instil into the eye a 5 to 10 per cent. solution of protargol, order a wash of saturated solution of boric acid and give the patient a prescription for the following solution, which is to be put in the eye freely and frequently during the day, after cleaning:

℞.	Hydrastin acetate..................	gr. i-ii		065-.13
	Boric acid	gr. x		65
	Borax	gr. xx	1	3
	Tr. opium (deod.)..................	m. xv		92
	Distilled water q. s....................	℥i	30	

In order further to safeguard the patient it is well to order the protargol solution and have it used several times during the interval between visits. At this point I take occasion to say that the above prescription has proved a most valuable adjunct in the treatment of these cases. It is the original Scott mixture, with hydrastin acetate[1] substituted for the hydrastin sulphate, the former being more soluble, while at the same time it is germicidal in its action and has a specially beneficial action on the epithelium. If the patient is an infant or one suffering much from photophobia I instil into the eye a drop or two of atropin sulphate, gr. i, distilled water ℥i, to put the iris at rest, and then give full instructions to parents or patients, as the case may require, and have the patient report in twenty-four hours. My reason for beginning the active treatment at once is that if the gonococcus is present it is best to begin the use of such remedies as will destroy the infectious agent before it has had time to penetrate the deeper structures and thus limit the ravages of the disease. That protargol is an effective agent is well established by the experience of Myles Standish, who used it with great success in a large number of cases, while Davier and other foreign observers speak highly of it. Knapp, of New York, has also recently spoken of this agent in the highest terms, preferring it to the silver nitrate on account of the fact that it is more penetrating in its effect and less irritating. If then we have a remedy capable of destroying the gonococcus when present, and of producing no serious trouble, even if that germ should be absent, why not use it just as we do the 2 per cent. nitrate of silver solution in Credé's method. Again, if we can destroy some of the gonococci before they invade the mucous membrane we can limit, in proportion, the amount of inflammatory reaction, which consequently modifies the after-symptoms to such an extent that we have fewer complications, such as conjunctival chemosis and intense swelling of the lids. I can see no reason for waiting until we have a marked flow of pus before we resort to the use of those remedies which are capable of destroying the active pus-producing agent. This method of anticipating the condition is used, and with most gratifying results, by my friend, Dr. Savage, who has had considerable experience in the treatment of such cases. But to return to our patient. If on the morrow we find that the infection has progressed, and that there is more or less secretion, mucus and pus, it becomes necessary to institute a more vigorous line of treatment. The irrigation should be as frequent as is necessary to keep the eye free from secretion, and following each cleaning some of the hydrastin solution should be instilled into the eye, and at stated intervals—some three to six times in the twenty-four hours, as the case demands—a protargol solution of 10 to 15 per cent. should be freely used. If thought best by the attending physician, after a thorough cleaning, the lids may be everted and the stronger protargol solution applied by means of a small cotton mop. As to this procedure there is some difference of opinion on account of the difficulty in everting the lids, especially in children, as it is not wholly without danger to the cornea. Then, too, the free use of the protargol will cause it to permeate the utmost limits of the conjunctival sac and thus avoid the necessity of everting the lids for a direct application. By some nitrate of silver is regarded as the most reliable remedy to use, but it can not be used continuously nor can it be used properly except by one of experience. If it is used according to the suggestion of de Schweinitz, that is, a 2 per cent. solution applied directly to the exposed conjunctiva with a cotton mop and then the pellicle washed off with a physiologic salt solution, in my opinion we have defeated the object in view. In removing the coagulated albumin and in the neutralizing of the excess of the silver we have at once removed the active germ destroyer and left behind an open field for the further invasion by the undestroyed gonococci lurking in the deeper layers of the mucous membrane. If at this point, that is, after the nitrate has been used, the excess neutralized and the pellicle removed by the physiologic salt solution, you follow immediately with the instillation of the protargol solution you have gained a double advantage, for the removal of the coagulum leaves behind a deeper level of the membrane which has not been penetrated by the nitrate, but in which the gonococci are still present, and it also immediately opens up a direct avenue through which the protargol can enter and destroy the enemy. In thus using the nitrate you have gained all that can be gained from this agent, for the coagulum is inert and in its exfoliation by natural processes it may become a source of irritation. Again you have cleared the way for another agent, which is both more penetrating and less irritating, and by reason of the fact that it can be used frequently and freely is more capable of producing beneficial results.

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[1] The hydrastin acetate is made by taking 2 grains of hydrastin alkaloid and 3 drops of acetic acid.

In this connection it might be well to call attention to a few facts concerning the action of silver salts, as recorded by experienced observers. Cushny says: "The precipitation of silver nitrate by proteids and chlorids confines its disinfectant action to narrower limits than those of some other antiseptics, and this has led to the introduction of a number of other compounds which are less easily dissociated, and, accordingly, less liable to be thrown out of solution." Continuing, he refers to argentamin, saying: "It penetrates better than nitrate of silver, but the alkaline diamin renders it somewhat irritating." Again he says: "Argonin, which is a combination of casein and silver, is soluble in water and, like argentamin, is not precipitated by chlorids and albumin."

Protargol, according to Porter, contains only 8 per cent. of silver, is an albumose of silver and quite penetrating, while argyrol contains 30 per cent. of silver and is a combination of silver and vitellin, and collargol contains 97 per cent. of silver. These percentages of silver in argyrol and collargol are considerably higher than those given by some. In a recent article[2] de Schweinitz, in referring to the use of argyrol, speaks of the experiments of Dr. Derby of Boston with this preparation, who found that it did precipitate in the presence of albumin and that it was exceedingly weak in bactericidal action. He further says that C. R. Marshall and E. F. M. Neave, of England, practically confirmed the conclusions of Derby, and "they found that argyrol, and also collargol, posses practically no bactericidal action whatever, and, moreover, that the percentage of silver which these compounds contain is no criterion of their bactericidal power. Therefore, any good effects, as they point out, which many clinicians maintain that they have obtained with argyrol, can not be attributed to any action which it has on bacteria, inasmuch as such action is practically *nil.*"

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[2] Therap. Gaz., Jan. 15, 1907.

Now, these reports are, to my mind, very pertinent, for I think they carry with them the probable solution of this question as to the most reliable silver compound to be used in these cases. We have seen that silver nitrate, which is a powerful antiseptic and germicide, is limited in its bactericidal action by reason of the fact that it is precipitated by proteids. This prevents it penetrating the deeper layers of the mucous membrane, and consequently it fails to reach the micro-organisms which lie beyond the coagulum produced, while, of course, those which are free in the conjunctival sac are destroyed by this very coagulation or precipitation, since they are proteid matter.

Again, argyrol, which contains, according to some, 20 per. cent., and according to others, 30 per cent. of silver in the form of vitellin of silver, is a nucleo-proteid compound. Vitellin is a nucleo-proteid of that variety which, when decomposed, yields proteid and paranuclein. Now, proteids are not absorbed as such, but must be converted into proteoses or albumoses when absorption takes place rapidly, and it is said of paranuclein that it "is probably absorbable." Hence in this combination, argyrol, we have a feebly penetrating agent, and consequently one which can not be relied on to destroy those organisms which have penetrated the tissue with any degree of rapidity; therefore, development exceeds destruction of gonococci, rendering the remedy too slow and unreliable.

Protargol is an albumose-silver compound containing only 8 per cent. of silver, and it has proven effective in the treatment of this form of trouble on account of its penetrating capacity.

Attention has been called to the fact that proteids, as a rule, are absorbed only when they have been converted into proteoses or albumoses; that is, in order for them rapidly to penetrate animal membranes with facility and certainty they must be in this form. This being true, if we can get a recognized germicide in that form which can and will penetrate animal membranes we have an ideal agent to attack and destroy the gonococci, even though they are entrenched in the deeper layers of the conjunctiva. In protargol, the albumose of silver, we have an agent, highly germicidal in its action, meeting the physiologic demands for easy absorption or deep penetration. Clinical experience with protargol, in the Nashville City Hospital, in the practice of Dr. Savage, has fully demonstrated its value both as to its use in cases which had reached the stage of pus as well as in those in which it was used just after infection and before the symptoms developed. In the former the gonococci were not found in the pus after the third day, as a rule, and one of the house surgeons who became infected from a case under treatment, and who received the treatment as I have described it, was practically well in six or eight days.

As to the practical value of the method of treating these cases as I have outlined a case will illustrate. I operated on a young man for internal squint, tucking the external rectus and making an extensive partial tenotomy of the internal rectus. The operation was done on Tuesday, the stitch removed on Saturday. He was seen Sunday and all was well, but on Monday when I reached my office he was there complaining of the eye, saying it began to trouble him about 5 a. m. Examination showed considerable irritation, slight secretion, but no pus. I failed to get any history to fix the cause, but I cleansed the eye, ordered the boracic acid irrigating solution and the hydrastin mixture, used the protargol. gave him and his friend full instructions and ordered him to report that afternoon, which he did, and I found more secretion, slightly muco-purulent. Next day there was found marked purulent secretion, and I became convinced in my own mind of the cause, though I could not get it from either of the young men. I pushed the treatment, and next day when he was seen both he and his friend announced that they were the victims of specific urethritis. In twenty-four hours he had developed a case of epididymo-orchitis, though his eye was progressing nicely. By the middle of the next week he was practically well of his ophthalmia, and in a few days more the gentleman whom I had called in to treat his specific urethritis with complications had him ready to return home. This case offered every opportunity for a serious condition on account of the operation on the muscles, and I believe if I had waited for pus and positive history the result would have been quite different. This method of treating these forms of purulent ophthalmia has proven most satisfactory, being modified to meet the conditions presenting in individual cases. Serious corneal complications are very rare when cases are seen early, and in those of known specific infection, if seen before the stage of pronounced pus production and vigorously treated, are practically *nil.*

THE TREATMENT OF IRITIS.*

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It would seem that very little remains to be said concerning the treatment of a disease so long recognized and so frequently encountered as iritis, but for those reasons the discussion should be sufficiently interesting and profitable to justify our Chairman in providing such a paper.

The varieties of iritis can be dismissed in a few words. The most useful classification is that based on the cause, which will be duly considered in this paper. As regards the local clinical manifestations, we may regard all iritis, from the point of view of treatment, as forms of plastic iritis, differing only in degree.

The object of the treatment of iritis may be stated, in the words of Brailey and Stevenson, as threefold:

1, To dilate the pupil; 2, to relieve pain; 3, treat any constitutional condition that may be present as a cause, as well as to attend to the patient's general bodily welfare and secretions.

I. DILATION OF THE PUPIL.

The object of this procedure is, as we all know, (*a*) to prevent the formation of adhesions, which may so lessen the size of the pupil as to interfere with vision, or to interfere with the circulation of the aqueous between the anterior and posterior chambers; (*b*) to diminish the volume or the iris, and thus to squeeze out the blood from it; (*c*) the drug which paralyzes the iris muscle affects the ciliary muscle similarly and puts both at rest; (*d*) it also acts as a local sedative.

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To dilate the pupil we must use a mydriatic drug. We must then consider (1) what drug, (2) in what strength, and (3) how and how often should it be applied.

There are not many drugs from which to choose, and if we omit cocain and homatropin as being of too feeble mydriatic power to be considered in this connection we have three left, namely: (*a*) Atropin, (*b*) scopolamin and hyoscin (which are possibly identical), and (*c*) hyoscyamin, daturin and duboisin (which are identical).

Without going at all into a discussion of things so often discussed, it suffices to say that of these drugs we unanimously choose atropin as the most efficient. Nor is it necessary to review the well-known questions of the chemistry of the mydriatic drugs, so fully elucidated long ago by Risley and others.

What strength solution shall we employ? The standard solution of four grains to the ounce may require modification either way. In patients presenting themselves for treatment with adhesions already formed, it may be necessary to increase the strength to eight grains to the ounce for a few instillations in order forcibly to break up the adhesions. On the other hand, in children, and in those susceptible to the drug, a weaker solution may be expedient. Under some circumstances a small solid crystal of atropin may be introduced into the eye, as will be mentioned later.

How and how often should we use the solution? This depends, too, on circumstances. In general four instillations in twenty-four hours, with the patient at rest, and under favorable surroundings, will suffice to keep the pupil dilated, and this is the index by which we gauge our therapeutics. When the patient is first seen it is well for the surgeon to instil the drops until the pupil is dilated, but we frequently seen that very little dilation is procured in one hour, while a continuation of the drops for twenty-four hours may break all the adhesions and give a round pupil. Even if this has not happened by the end of the twenty-four hours, it does not mean that the adhesions are permanent, for continued use of the drug may result in the continued rupture of synechia for as long as four or five days. When full dilation is secured, the frequency of the instillation should be reduced until the minimum dose which will maintain the mydriasis is ascertained. Briefly, this should be continued until the eye is free from redness.

If the drug fails to dilate the pupil fully, several expedients may be used. It is recommended, as has been mentioned, to place a small pure crystal of atropin in the lower cul-de-sac, and this, by its vigorous action, will often rupture adhesions which solutions of the drug will not affect. I have had no personal experience with this plan, since the danger of introducing so much of so powerful a drug into the circulation has seemed to me too great a risk. I hope that some of the members of the Section will speak of their experience on this point. Another expedient to increase the effect of atropin in dilating the pupil is to use it in combination with cocain. I prefer not to mix the solutions, but by keeping them separate either can be used more or less energetically without affecting the method of using the other. The drop of cocain should precede the atropin to secure the best effect. The cocain lessens pain and increases the contraction of the blood vessels of the iris directly and by its action as a mydriatic.

Of the adrenal preparations great things were expected in ophthalmic therapeutics, but it is doubtful if any good is to be attained by their use except in ophthalmic surgery. Indeed, some writers have argued that the blood is driven from the superficial vessels by their action and the deeper structures are more greatly engorged, so that an iritis would be aggravated rather than relieved by such a drug. While not admitting the correctness of this reasoning, we can at least agree that no apparent benefit is gained by the use of these preparations. Paracentesis of the cornea may be mentioned as a measure which would increase the sensibility of the eye to a mydriatic, although a measure rarely, if ever, used for that purpose. Dionin is a comparatively recent addition to our resources in ophthalmology, and one of its many reputed virtues is to enhance the action of mydriatics by stimulating the lymph circulation. It seems that considerable observation would be necessary to settle this point, though the literature of dionin would suggest abundant observation of its action. I am not satisfied that dionin is a certain and unfailing agent for this purpose, or, if certain, that it is superior to cocain. The application of heat, either dry or moist, by stimulating the circulatory activity of the eye, also aids in securing and maintaining mydriasis. Dry heat may be applied almost continuously, since with the means at our command the heat is usually not very severe, while moist heat is best applied at stated intervals for ten or twenty minutes at a time. On the whole, moist heat, being more energetic, is preferable; it is applied with a towel, gauze or other cloth wrung out of hot water, after the manner of barbers. The local abstraction of blood is of great value as an aid to the action of mydriatics. This will be spoken of again later.

Two simple measures are of great value as an adjuvant to mydriatics, and, in fact, to all our therapeutics in iritis, namely, proper protection of the eye from light, and rest. Not only is rest of the eye necessary, but rest in bed is a part of the treatment whose value must have been impressed on every one. I feel satisfied that every patient with iritis would be better off in bed till convalescence is established.

We formerly heard a good deal about "atropin catarrh," but it seems to be pretty well established now that this form of conjunctival inflammation is simply an infection from dirty solutions and dirty droppers. If the solutions are made with a saturated solution of boric acid, or other unirritating antiseptic, as the menstruum, and proper care of the droppers enforced, this condition will rarely be seen. Before leaving the subject of the drops, we should be reminded of the virtue of warm solutions for this purpose. A little point which I saw from the pen of Dr. Casey Wood has been worth much to me, namely: First draw some hot water into the dropper, then expel it, and draw up the solution of the drug. This insures a clean dropper and a warm solution, and correspondingly less irritation to the eye.

II. TO RELIEVE THE PAIN.

The state of the pupil and the comfort of the patient together guide us in forming an idea of how satisfactory is the progress of a case of iritis. The use of the mydriatic, cocain, dionin, rest, protection from light, and the application of heat or cold, all contribute to the patient's comfort and freedom from pain, and while pain persists improvement is not imminent. Special consideration should be given to one or two of these measures. Dionin is much used as an ocular analgesic. In many cases the instillation of a 5 per cent. or 10 per cent. solution will relieve ocular pain for several hours, and it may be repeated as often as necessary. In my experience, it frequently fails to produce this happy effect, while moist heat is much more reliable for the purpose, applied as above stated. Continuous dry heat of lesser degree is often soothing. Cold applications seem to be of the most value in traumatic cases, with threatened or feared suppuration. In such cases the application should be continuous as long as it is needed at all. It occasionally happens that a patient with ordinary plastic iritis prefers the effect of cold to that of heat, in which case cold may be used continuously or intermittently.

We must often give anodynes internally. The various preparations of opium are most effective, but unpleasant by reason of the systemic distrubances to which they give rise. A mixture of antipyrin and salicylate of soda in moderate doses is a very efficient anodyne, five grains of the former and seven and one-half of the latter in simple elixir being a convenient form and dosage.

Counter irritants have a place in the treatment of iritis. A blister behind the ear, or one on the brow or temple, is of some value, but this measure is rarely used, as the same effect can be better attained, and, on the whole, with less disturbance to the patient, with leeches. Except in hospitals, artificial leeches are apt to get out of order from lack of use; hence the natural ones are preferable, and their value is very great. Four to the temple will contribute greatly to the relief of pain and to the dilatation of the pupil. McKenzie long ago mentioned the favorable effect of general blood-letting on the action of mydriatics, and the local abstraction of blood is even more gratifying, though probably not so much used as its merit deserves that it should be.

Sometimes pain in the course of an attack of iritis is due to an increase of tension, or the increased tension may be present without any special increase of pain. Special means for the relief of this symptom are hot applications, a myotic drug and paracentesis. Hot applications may so stimulate the circulation of the eye that the excessive fluid will be disposed of and the symptom subside, but most often this does not occur. If the tendency to the formation of adhesions is not marked, we may use a myotic, alternating with the mydriatic, or at least dilating the pupil once in the twenty-four hours. If this does not control the situation, paracentesis may be done, and my preference would be to do this early and repeat it. No special precautions are necessary in its performance under these circumstances, and the relief is prompt. The mydriatic is continued and the operation repeated if necessary.

III. THE CONSTITUTIONAL TREATMENT.

Under this head we should include not only the treatment of any constitutional condition that may be a cause, but any disturbance of function, nutrition or metabolism that could in any way retard the cure of a local condition, or interfere with the action of remedies. The bowels, skin and kidneys in particular should be kept sufficiently under watch to insure the proper performance of their functions, without which no treatment can accomplish its greatest good.

Every one who writes on iritis repeats the statement that 50 per cent. of cases are due to syphilis and one-half of the remainder to rheumatism. When the therapeutics of the latter is as certain as the therapeutics of the former, the treatment of iritis in the rheumatic may be more satisfactory, though we should hasten to add our thanks at the relative amenability of the iritis as compared to the joint manifestations.

It is a question as to how far such a paper as this should attempt to deal with the treatment of possible causes of iritis. A little latitude in this direction would result in the production of a compend on the "Practice of Medicine." Only a few matters need be considered and certain well-known facts may be hurried over. The fact that the iritis of syphilis is usually an early secondary manifestation would give us the hint as to mercury, even if the observation of the effect of mercury on the iritis itself did not lead us to that conclusion. In iritis in any stage of syphilis, mercury gives by far the best results and is best given by inunction. The more marked the plastic features of the inflammation the more urgent is the need of mercury and the more striking are its effects. It may be said here, and will be elaborated later on, that it is by no means in syphilitic iritis alone that mercury is of value, but in plastic iritis of whatever origin. It is thought that the energetic treatment of primary syphilis will prevent iritis, as well as the other secondary manifestations.

The subconjunctival injection of mercury was ardently advocated by Darier, who reported especially good results from it in specific diseases of the eye. It seems settled that the action is not specific or antibacterial, but that the good results are due largely to the increased circulatory activity, and similar results are obtained, with much less pain, by normal salt solution. The mercurial preparation is a 1 per cent. solution of either the bichlorid or cyanid, of which from one to three minims is given at a dose.

In an iritis which is manifestly or presumably of rheumatic origin, the indications for internal treatment are less clear in proportion as the pathology and therapeutics of rheumatism and the allied states is not exact. The salicylates, alkalies, hot baths, regulation of diet, confinement to bed to secure the advantages of the equable temperature, in addition to the rest, all have their place. Frank[1] has had favorable results in rheumatic iritis from the local application of an absorbable salicylic acid compound, called mesotan. This is mixed with equal parts of cotton seed or olive oil and rubbed into the skin around the eyes. It is probably in connection with rheumatic, lithemic and gouty conditions that Brudenell Carter cautions against the "attempts of certain writers to draw the trail of a sometimes imaginary diathesis across the manifest phenomena of an obvious malady." It is certain that the internal treatment in this class of cases does not always confer conspicuous benefit, and we should not rely on it to the prejudice of energetic local measures.

A few cases of iritis have been reported by Jacobson[2] and Pechni which were apparently due to malaria. The proof is not conclusive, but in such cases quinin should be administered, the time and quantity being determined by the blood examination.

Tuberculous iritis presents particular therapeutic indications. In addition to a vigorous supporting plan of internal medication, the injection of tuberculin, injections of air into the anterior chamber and various general medicaments, have been advised. Heath[3] treated one case by injecting air into the anterior chamber, with unfavorable results, though he quotes favorable reports from Koster and Felix. The reports on tuberculin are hardly more encouraging. Falkenburg[4] observed three cases, two of which he treated with tuberculin. In both of these enucleation finally became necessary and both patients later died of meningitis. The third patient received no tuberculin and at the end of five years was in good health. Nevertheless it would seem advisable to administer tuberculin, but unless improvement sets in promptly the eye should be removed.

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[1] Amer. Jour. of Ophthalmology, June, 1904.
[2] Amer. Med., Feb. 8, 1902.
[3] Ophth. Record, May, 1904.
[4] Inaug. Diss., Tübingen, 1901.

Treacher Collins' article on "Intraocular Tuberculosis"[5] came to notice while this paper was being prepared. It only emphasizes the uncertainty which attends the use of tuberculin, but the majority of the evidence, especially the experimental evidence, both with old tuberculin and tuberculin TR is adverse.

A variety of causes have occasionally been found to be at the bottom of a case of iritis. Thus Fage[6] saw a patient with iritis who had also ozena, but no other apparent cause for the iritis. Nasal antisepsis seemed to hasten the cure. We frequently seek in the nose for a cause of chorioiditis, and it is not a surprise to have so pronounced a nasal affection fastened on as the cause of iritis. Westhoff[7] observed iritis as a symptom of iodism, and cases have been reported plainly due to oral sepsis. These few instances will at least serve to show how far we should seek for the cause of iritis, since, when found, its elimination often simplifies the management of the ocular condition very materially.

Aside from its relation to cause, the internal treatment of iritis is of much importance. As has been intimated, besides their action in those cases manifestly due to syphilis or rheumatism, mercury and the salicylates are of great value in other forms of iritis. Mercury seems to be specially indicated in cases with much plastic exudation, early tendency to the formation of adhesions, and the rather uncommon type in which a large transparent mass forms in the anterior chamber, the spongy iritis of Knapp. This exudate melts as if by magic under the influence of mercury. In my experience, the drug is best given by inunction, though painting on the oleate or deep injections of bichlorid or of gray oil may be used. Except in chronic cases or cases associated with chorioiditis and running a slow course, I am not favorably impressed with the action of iodids in iritis.

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[5] Ophthalmoscope, February and March, 1907.
[6] Oph. Rec., 1898, p. 32.
[1] Med. Weekblad, 1898, p. 16.

Nor are sweats apparently so potent as in chorioiditis or a general uveitis, but they are of undoubted value nevertheless, as has been pointed out before this Section by Drs. T. A. Woodruff and Hiram Woods. Given in the manner suggested by the former, the activity of other measures is notably increased, and the systemic cleansing is also of great benefit. While pilocarpin has many advantages in producing sweats, other means may be resorted to, such as vapor baths and Turkish baths. In this connection mention should be made of what Burnham of Toronto calls his "combined method." It consists in administration of bichlorid of mercury, 1/24 gr., with potassium iodid, grs. 5 to 10, and on alternate day a hypodermic injection of pilocarpin, grs. 1/12 or more. He claims that much benefit results from this treatment in iritis and iridocyclitis and various other ocular diseases. The treatment is given for twelve days and the pilocarpin is left off for from one to six weeks, to be given again for twelve days. The treatment is to be continued indefinitely, according to the needs of the particular case. Burnham's claims for this plan of treatment sound extravagant, and as far as I know no one else has followed exactly this plan. It is certainly well worth a trial.

THE TREATMENT OF INTERSTITIAL KERATITIS.*

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SAVANNAH, GA.

I have not attempted an academic paper on the treatment of interstitial keratitis, but have rather endeavored to give a paper based on clinical observations; and in order to get the conclusions and opinions of others, the following questions were addressed to thirty representative ophthalmologists in as many different sections of the country:

1. *What local measures other than those for the alleviation of symptoms have you used in the treatment of interstitial keratitis?*
2. *To what extent have any of them contributed to the shortening of the inflammatory stage?*
3. *Do you administer iodids during the inflammatory stage? In your opinion do iodids, given during the inflammatory stage, aid or retard recovery?*
4. *What, in your opinion, is the best method of administering mercury?*
5. *What is the average duration of the inflammatory stage in your practice?*

The answers to questions one and two were surprisingly uniform. Subconjunctival injections, cold water dropping, massage, ointment of yellow oxid of mercury, electricity, dionin and many others receiving honorable mention, but doubtful recommendation; and not in one single instance was there a clear convincing statement that any of them had contributed to the shortening of the inflammatory or progressive stage of the disease, showing conclusively that I am not alone in the opinion that local measures (except those for the alleviation of symptoms and complications) are of no value during the stage of infiltration and vascularization.

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The answers to the third question with few exceptions coincided also with my opinion that iodids internally are useless, if not positively harmful during this stage.

A large majority of the answers to the fourth question indicated preference for inunction in the administration of mercury.

The answers to the fifth question could be divided into two classes: Those from men who assume that congenital syphilis is the sole cause of interstitial keratitis and treat it accordingly, and those from men who assume that there are other causes for this disease and who do not rely on antisyphilitic treatment alone. It is a significant fact that the former, as a rule, gave the average duration of the inflammatory stage in weeks, while the latter gave it in months; therefore, the majority, I think, will agree with me in the assertion that the treatment of interstitial keratitis resolves itself into the treatment of congenital syphilis, with appropriate measures for the relief of its most prominent local symptoms, the combating of complications arising from involvement of the uveal tract and for the more rapid and complete clearing up of the corneal opacities. The treatment of congenital syphilis as well as of the acquired variety consists mainly in the judicious administration of mercury with the most careful attention to diet and hygiene, and I contend that the most stubborn and persistent cases will yield to scientific endeavor in that line. Unfortunately, however, a great many of us have fallen into the habit of empirical application of routine methods in the treatment of syphilis instead of making a careful study of each case and meeting all its indications. Hence, one may read in almost any textbook on this subject something like the following confessions of failure:

"Mercurial treatment, which is of such marked service in acquired syphilis, is here ordinarily less efficient; and "'Many cases of interstitial keratitis, even under the most careful treatment, run a course which is not essentially different from what would have been the case without any treatment at all."

Both of these conclusions are erroneous and are the result of empiric methods in the treatment of this disease. For instance, a great many men give large doses of iodids along with mercury without any fixed idea or purpose, simply as a routine practice. This, in my opinion, is entirely wrong. Careful observations have forced me to the conclusion that iodids have no place in the treatment of interstitial keratitis during the stage of infiltration and vascularization, mercury alone being the essential drug, and it must be given with the utmost discrimination, each case being a law unto itself. The toleration for mercury must be carefully estimated from time to time, for it varies in a given individual as well as in different ones. It must always be pushed to the limit of toleration until the infiltration and vascularization have been definitely arrested.

I am convinced that it is the condition of mercurial saturation in a patient that combats syphilis rather than the drug itself, and if one would have results, that condition must be maintained with the utmost nicety, varying the amount administered from day to day if necessary. Mercury as a specific, like other antitoxins, should have no fixed dose. Of the many methods that have been devised for administering it, inunction of a carefully prepared blue ointment is, all things considered, the most satisfactory and the most effective. It can be obtained at drug stores in gelatin capsules containing a definite amount of the drug; the capsules keep it fresh and soft under all conditions. Administration by mouth is the least satisfactory method of all, as it interferes materially with the digestion and assimilation of food, irritates the alimentary tract and in many instances is not absorbed at all. Hypodermic administration of mercury, while effective, is impracticable unless the physician attends to it personally, and it is extremely painful and terrifying to a child.

In my practice the inunctions are given on alternate nights after a hot soap and water bath and are not confined to any one part of the body; on the contrary, the ointment is distributed over a large area with gentle rubbing occupying not longer than fifteen minutes. A suit of union underwear is then put on and worn continuously until the time for the next inunction, when a hot soap and water bath is again given; the process is repeated on alternate nights, increasing or decreasing the amount administered as the symptoms of mercurial saturation indicate, endeavoring at all times to keep the patient just on the verge of absolute ptyalism. In children under ten years of age the initial dose is 10 grains, increased to 15 or even 20. In children over ten years of age and in adults the initial dose is from 10 to 30 grains, increasing to 60 in adults and from 20 to 30 in children. This is continued without intermission until the progressive stage has been permanently arrested (a fact easily determined by the abatement of the characteristic symptoms): then an intermission of from ten to fifteen days is ordered. Up to this time no iodids are given under any conditions. When the administration of mercury is resumed it is commenced again with the initial dose and increased to one-half of the maximum given during the inflammatory stage. If by this time there are no signs of renewed infiltration and vascularization the iodid of iron is given in liberal doses, together with the continued administration of mercury.

From the beginning the patient should be in a hospital, but should not under any conditions be confined to a dark room or even to the house; on the contrary, should be allowed full out-door liberty, with suitable protection from light. The diet should be principally milk and eggs: cod liver oil is useful but not essential; and if the patient is much run down stimulants are ordered in the form of a milk punch three or four times a day. The patient should be frequently weighed, and an occasional blood count will give valuable information. The tincture of the chlorid of iron is often given during the active treatment and seems of great benefit when indicated. In my experience patients under this régime gain rapidly in weight, health and strength, the vascularization and infiltration of the cornea are limited, and if the case is seen early the inflammatory stage rarely extends over four or five weeks.

For the relief of the local conditions all the methods that are applicable to other inflammations of the cornea and uvea are beneficial in these cases. Hot applications are always grateful and are well borne. Leeching will often relieve the most aggravated cases, but never so promptly as in acute inflammations; leeching also aids in securing dilatation of the pupil, which in itself relieves pain. Of the mydriatics I prefer atropin, but in these cases it must be used in stronger solution than in ordinary acute conditions, as the iris is usually very rebellious, and with the best endeavors the physician will not be able to maintain a complete relaxation of the iris and ciliary body during the active stage of the disease.

To facilitate resolution and clearing up of the inflammatory deposit, ointment of yellow oxid of mercury, calomel dusted into the conjunctival sac and subconjunctival injection of normal salt are useful, but rarely necessary, the clearing up process usually progressing very satisfactorily under the constitutional treatment.

After recovery the patient should be kept under observation for about six months at home and should take moderate doses of mercury by the mouth with intermissions and liberal doses of iodid of iron, together with good nourishing diet and full out-door liberties.

THE TREATMENT OF RECENT TRACHOMA.*

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In order to avoid any misunderstanding as to what is meant by the term "recent trachoma," it is necessary to state that it relates to that period of early infection of the conjunctiva by a disease which is more or less infectious in its nature and chronic in character from its onset. It in no way relates to those acute exacerbations frequently seen during the course of the same disease. Probably a better term would be the incipient or primary stage of trachoma. For the mater of convenience, and without giving a too minute description, I have divided trachoma into four stages, each stage being merely a condition reached in the process of the development of the disease, and not a separate variety.

Clinically, the first stage closely resembles, and is with difficulty diagnosed from, ordinary follicular conjunctivitis. It is the period of the primary infection, whatever that may be. It is characterized by the presence of enlarged follicles, more or less irregularly distributed over the palpebral conjunctiva, and especially present in the retrotarsal folds, and more rarely in the ocular conjunctiva. Accompanying this is more or less congestion of the conjunctiva.

As the disease advances we reach the second stage, in which the conjunctiva covering the tarsus becomes hypertrophied and thickened and thrown into folds, taking on a velvety appearance from the decided enlargement of the papillæ. Although there is usually no intense inflammation, there is moderate redness and the lids are gummed together in the morning. This is the stage in which the disease is most commonly first recognized.

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In the third stage the conjunctiva becomes greatly hypertrophied and the granulations are with difficulty or not at all recognized, on account of the swelling which gives the conjunctival surface a smooth, succulent and thickened appearance. In this stage the corneal complications, pannus, ulcers, etc., are frequently present.

In the fourth stage the swelling subsides and the swollen and inflamed conjunctiva is replaced by cicatricial tissue which shows itself by the presence of white lines on the tarsal surface of the lid. This is accompanied by contraction of the lids and the presence of unfortunate sequelæ which show themselves as the result of the cicatrices present in the palpebral conjunctiva and the advancement of the disease to the adjacent parts.

I have not attempted to give an exhaustive description of the various changes that take place in the structures attacked by trachoma, but have roughly outlined the course of the disease from its incipiency by dividing it into stages that appear to me convenient for the purpose of this paper. Although no hard and fast line can separate the various stages from one another it would seem feasible that such a division should be made if we are to consider the disease under its various headings. The term "recent trachoma" would be included in the first two stages, the period when it is usually first recognized. If treatment is of any avail, more opportunity of arresting the progress of the disease is to be expected during these stages than later when permanent alterations have taken place in those parts attacked by the pathologic processes.

As a rule, the early stages of trachoma are not accompanied by any marked degree of inflammation, the patient suffering very little from those unpleasant symptoms that are found in the more advanced stages of the disease.

The early recognition of trachoma is important, as much can be done in the way of effecting a cure if treatment is begun early and is carried out intelligently and persistently. Diagnosis during the first stage is surrounded by many difficulties, and, in fact, few cases are seen at this period except in those communities in which trachoma is prevalent and therefore recognized as such. The patient rarely complains of any marked or unpleasant symptoms, although well-defined changes in the conjunctival surface of the lid are recognizable, and it is with difficulty that the patient can be induced persistently to undergo and to carry on a treatment that is troublesome, especially when the disease causes him so little inconvenience.

Although diligent search has been made for it, so far no specific germ has been isolated which can be held as a direct causative factor in the production of trachoma. We are, unfortunately, still in the dark regarding the real nature of the infection. Nevertheless, we are justified in assuming, from its well-known infectious character, that it depends for its origin and propagation on the presence of some organism.

Fortunately, in this country trachoma has not obtained to the same extent that exists in Europe, and owing to the quarantine regulations at our ports of entry, it stands little chance of making great headway. Still it does exist in certain sections, and those affected are a standing menace to all with whom they come in contact. As trachoma is a disease which has its origin and depends for its propagation on filth and uncleanliness, as well as on insanitary surroundings and defective hygienic conditions, it is essential, if we wish to eradicate it from the communities in which it has obtained a foothold, that attention should be given to the education of the people, not only as to the infectious nature of the disease, but as to the improvement of the conditions in which they live. They must be taught that not only is it necessary to observe the ordinary laws of personal cleanliness, but that trachoma can be communicated from one person to another through the discharges carried on towels, handkerchiefs, etc., which are daily used by those affected. It is no uncommon sight, especially in the country districts where numerous cases of trachoma are found, to see the tin wash basin, which is used in common, not only by members of the family, but by any stranger or farm hand who comes along, the same towel being used promiscuously as well. No thought is given to the dangers that accompany such acts. Absolute measures of isolation should be enforced in every case and absolute cleanliness and strict attention to personal hygiene and the improvement of sanitary surroundings insisted on. Similar precautions should be taken to those used in the prevention or blotting out of other contagious diseases. Measures of this sort, especially if they are instituted early, will have a marked influence on the spread and malignancy of the disease.

In considering the large number of remedies and the variety of measures, mechanical and surgical, recommended for the cure of trachoma, we are confronted with the fact that we have to deal with no ordinary inflammatory infection, but with a chronic disease whose resistant power is so great that we have at our disposal no remedy with which we may assert that its employment will effect a speedy cure, if one at all.

In its early stage much undoubtedly can be done by way of arresting the progress of the disease or even of curing it, if it were easy of recognition at the time of first infection; but, unfortunately, it is not until the disease has so far advanced as to cause inconvenience to a patient that a chance is given to resort to measures that in any way give fair promise of proving successful in eradicating it. So many remedies, as well as manner and methods of treatment, have been recommended that the literature is full of so-called cures of trachoma, each observer claiming beneficial results at his hands from the use of those measures advocated. To my mind, this shows the obstinacy of the disease, and that so far we have been unable to obtain anything that can be considered as a specific; it also teaches us that we must apply those measures that seem beneficial in each individual case.

The use of the x-ray[1] has been highly recommended by a number of observers, while others have not been enthusiastic in the results obtained, and claim that the benefits derived from its use were inferior to the ordinary therapeutic agents or operative procedures. In those cases in which success is reported, much benefit resulted from the application of the x-ray in the earlier stages, before the granulations were abundant and before the deeper layers of the conjunctiva were involved. The earlier it is applied the more satisfactory is the result, and a more rapid absorption of the granulation takes place.

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[1] Stargardt: Ztschr. f. Augenheilk., September-October, 1905. Vassiontinisky, (A. G.): New York Med. Jour., March 4, 1905. Mayou: Lancet, Feb. 28, 1903. Stephenson and Walsh: Med. Press and Circular, Feb. 18, 1903. Goidzieher, (W.): Wien med. Wochschr., liv. de Schweinitz, (G. E.): Ophthalmic Year-Book, 1905, p. 54. Harmon, (N. B.): Brit. Med. Jour., Aug. 26, 1905.

Radium[2] has been successfully used by some, while others have obtained no satisfactory results from it in the treatment of this disease.

When granulations are abundant their early removal is indicated. This is best accomplished by means of expression with one of the several forceps made for the purpose. Great care should be exercised in performing this operation not to use too forcible pressure, so as to avoid laceration of the tissues. This procedure often gives excellent results, and is especially indicated in the early stages of the disease in which the granulations are large and exuberant, and fill the upper and lower culs-de-sac. Although of less value, it is not contraindicated in the later stages of the disease or when corneal complications are present. The reaction produced by this procedure is usually not very severe, and is readily overcome by the application of cold fomentations to the lids. This should be followed by applications of sulphate of copper either in the form of the solid stick or in solution.

In the early stages I think the best results are obtained from the copper in solution, the solid stick being more applicable to the later stages of trachoma, when the trachomatous bodies have invaded the deeper tissues and the more escharotic effect is desired. The solution should be as strong as can be comfortably borne by the patient and without setting up too severe a reaction. It should be brought in contact with all portions of the diseased area and applied well into the culs-de-sac by means of cotton twisted around a toothpick after complete exposure and thorough drying of the conjunctival surfaces, with a pledget of cotton or sterilized gauze. This procedure may be repeated as often as is considered desirable, care being taken to dry the conjunctiva before each application. I use a saturated solution of sulphate of copper in glycerin (90 grains to the ounce), and from this make a fresh solution with water each day by the addition of fifteen drops of distilled water to one drop of the glycerid of copper. The strength of this is gradually increased until the point of toleration is reached. If this treatment is carried out daily or every other day, much can be accomplished in the absorption of the granulations and in cutting short the disease. Alternating with the copper solution, massage with an ointment made up of nitrate of mercury and cod-liver oil,[3] a small quantity of which is placed on the upper part of the globe beneath the upper lid and then distributed over the anterior surface of the eyeball by having the patient rotate the globe in various directions. The upper lid is then gently massaged with the finger from one to three minutes, the patient meanwhile turning the eyeball well downward. The lower lid should be treated in a similar manner while the globe is rotated upward. If the granulations persist, direct massage of the exposed conjunctiva may be practiced; powdered boric acid is dusted over the surface of the everted lid and well rubbed over the granulations, even to the point of bleeding, with the ball of the finger. This can be done with very little pain or discomfort to the patient, and acts very effectually in the absorption of the granulations. If the disease becomes acute and discharge is present, nitrate of silver should be used in a solution of from 1 to 2 per cent., thoroughly painted on the palpebral conjunctiva and well into the culs-de-sac, in a manner similar to the method of applying the copper solution. This should be followed by irrigation of the conjunctival sac with a physiologic salt solution for the purpose of washing away any excess of silver.

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[2] Beck: Ann. of Ophth., July, 1905. Falto: Wien. med. Wochschr., July, 29, 1905. Cohn, (H.): Berlin klin. Monatsb., Nos. 1-2. Birch-Hirschfeld: Klin. Monatsb. für Augenheilk., December, 1905.

The patient should be removed from all unhealthy surroundings and placed where he will receive an abundance of fresh, pure air. His sleeping apartment should be well ventilated and the general health improved when it is defective, and all near-work should be prohibited. Any existing errors of refraction should be corrected. The eyes should be protected from all irritating influences, such as bright light, wind, dust and smoke, by the wearing of protective glasses. These may be tinted or not, depending on the photophobia present, and the rim should fit closely to the neighboring parts, so as to preclude the admittance of irritating material into the eyes.

As routine treatment, the application of cold fomentations to the closed lids, every two or three hours, and the frequent cleansing by irrigation of the conjunctival sac with non-irritating antiseptic solutions, such as boric acid or bichlorid of mercury 1-10,000, should be carried out by the patient at home; one of the best of these is a 1-5,000 solution of formalin. Every particle of secretion should be removed by gently washing it away. When discharge is present the use of a solution of argyrol, from 10 to 20 per cent., instilled into the eye two or three times a day will prove beneficial. A 10 per cent. ointment of citrate of copper has been highly recommended for use by the patient at home. It is well to remember that trachoma is a chronic disease from its onset, and displays a stubborn resistance to the many remedies and procedures used for its relief. It is only by persistently keeping up treatment and varying it from time to time as the case demands that we can hope to arrest the progress of the disease and prevent those disastrous sequelæ which, invading the eyeball and deeper structures of the lid, result in lifelong suffering. I especially desire in this paper to emphasize the fact that it is impossible to lay down any routine treatment applicable to all cases, as the clinical picture in trachoma is a constantly changing one, requiring frequent observation and variation in the treatment.

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[3] Ung. hydrarg. nitratis is made with: Cod-liver oil (brown), 60 parts; cod-liver oil (white), 40 parts.

COMPARATIVE POTENCY OF HYOSCIN AND SCOPOLAMIN HYDROBROMID IN REFRACTION WORK.*

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Some years age in some notes[1] on the mydriatic alkaloids I made mention of a youth of 16 with emmetropic eyes on whom I had tested the effects of hyoscin hydrobromid and scopolamin hydrobromid. One drop of a 1/10 per cent. solution of the hyoscin salt was used in the right eye and one drop of a 1/10 per cent. solution of the scopolamin salt was used in the left eye. The effect of the two drugs on the pupil is shown in Figure 1 and on the ciliary muscle in Figure 2. From these results I leaned to the conclusion that the two drugs were practically identical in action and, therefore, interchangeable, and I so put myself on record at that time. For some time afterward I ordered 1/10 per cent. of solutions of scopolamin or hyoscin hydrobromid indiscriminately in my office refraction work, but it was not long before the scopolamin cases began to show uncertain cycloplegia, while the hyoscin cases seemed to be much surer in result. Cases were, therefore, sought out that offered favorable conditions for further pharmacodynamic comparative tests of the two drugs. Within two years three persons were found who were so doubtful about the acceptance of even a plus 0.25 D. sphere (under cycloplegia) as to fit them for these tests. One showed two degrees of esophoria, one showed one degree of esophoria and one lateral balance. The first was 26 years of age, the second 22 years of age and the third 20 years of age. In the right eye of each of these patients was instilled one drop of a 1/10 per cent. solution of hyoscin hydrobromid (Merck) and in the left eye of each patient one drop of a 1/10 per cent. solution of scopolamin hydrobromid (Merck). These solutions were prepared for me by Messrs. Shinn & Kirk, of Philadelphia, who dissolved the drug in saturated boric acid solution and then filtered the solution. Mr. Kirk himself exercised particular care in their preparation, as he had been told that they were to be used for experimental purposes. The two solutions were stood for three minutes in a flat-bottomed shallow bowl of water brought to a temperature of 80 F. A standard dropper was used, and after use in the right eye was carefully washed out before using for the left eye. Hyoscin was used in each case in the right eye and scopolamin in the left eye and all other minutiæ so arranged as to eliminate the possible sources of error. The effect on the pupil in each case is shown in Figures 3, 4 and 5, while the effect on the range of accommodation in each eye is shown in Figures 6, 7 and 8.

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[1] American Jour. Phar., 1899.

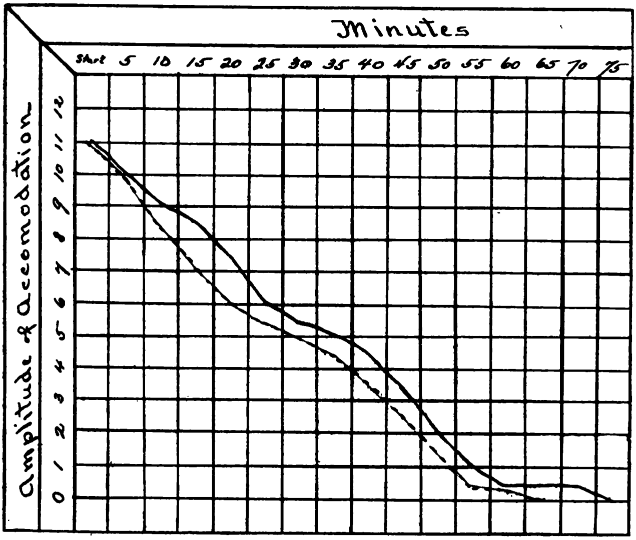

Fig. 1.—Effect on accommodation; T. K., aged 16. Scopolamin solid; hyoscin dotted.

PUPILS.

By reference to the figures it will be seen that the average time of beginning action on the pupil was ten minutes for both of the drugs in all of the eyes. Full dilation of the pupil occurred in the 22- and 26-year-old females in 30 minutes with hyoscin and in the 20-year-old male in 45 minutes. This may be attributed to the fact that the sympathetic nervous system is much more active in females than in males. The same difference in pupillary response was observable with the scopolamin.

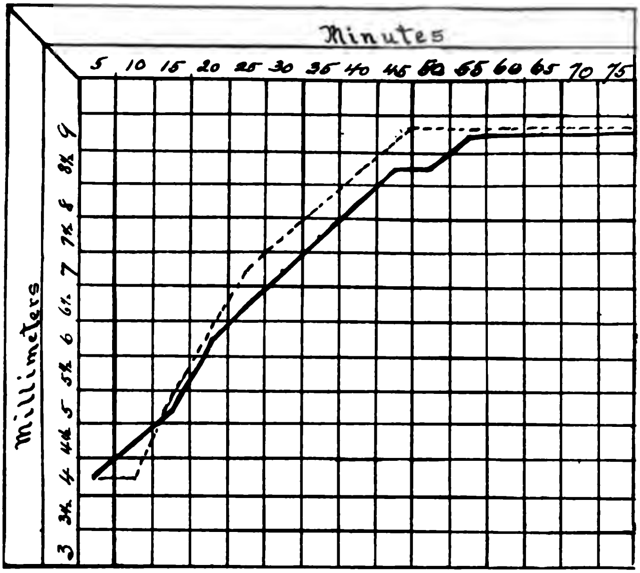

Fig. 2.—Effect on pupil. Scopolamin solid; hyoscin dotted.

In the two females full pupillary dilation under scopolamin occurred in 40 minutes and in the male in 60 minutes.

The pupils of the 20-year-old male were 0.5 mm. smaller in both eyes at the start.

According to these findings, therefore, hyoscin showed an average time of 35 minutes to produce full pupillary dilation in the three cases, while scopolamin showed an average time of 47 minutes to produce the same result.

ACCOMMODATION.

In Figures 6, 7 and 8 is plotted by curves the effect on the accommodation of each eye of the three cases tested. The curve indicating the hyoscin effect is shown by the broken line, while a solid line shows the scopolamin effect on the same patient.

In Figure 6 it will be noted that full cycloplegia was established in the right eye by one drop of the 1/10 per cent. hyoscin solution in 50 minutes, while an equal amount of scopolamin salt in the other eye did not bring about full cycloplegia until the expiration of 70 minutes.

In Figure 2 the onset of full cycloplegia also occurred in 60 minutes, while scopolamin in equal dose required 120 minutes to produce the same effect. In Figure 8 hyoscin produced full cycloplegia in 50 minutes and scopolamin in 100 minutes. If to these 3 cases we add the results in Case 1 above alluded to (Fig. 2) we find that:

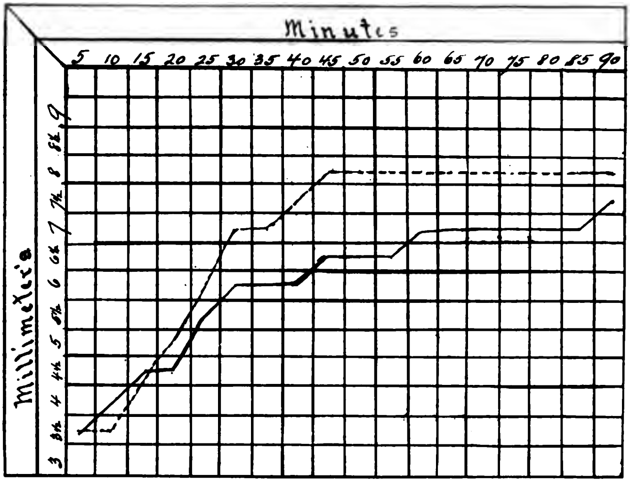

Fig. 3.—Effect on pupil.

The average time for onset of full cycloplegia under hyoscin (1/10 per cent. solution) in 4 cases was 59 minutes.

The average time for onset of full cyloplegia under scopolamin (1/10 per cent. solution) in 4 cases was 92 minutes.

So that the relative pharmacodynamic power of hyoscin hydrobromid and scopolomin hydrobromid as used in ordinary office work may be said to be somewhere close to 59:92. Or, to reduce it to the commoner form of statement, hyoscin in these test cases showed itself approximately 50 per cent. more potent than scopolamin in producing cycloplegia for refraction work. So much for the academic phase of the matter which seems to be rather at variance with the claims which chemistry makes for these two drugs.

CHEMICAL CONSIDERATIONS.

Since 1833, when Phillip Geiger announced that along with Hesse, he had succeeded in obtaining from some domestic poisonous plants the alkaloids atropin, hyoscyamin and daturin, down to the present day there have been not only numerous additions to this alkaloidal family, but there has continued a more or less animated discussion as to the properties of the several principles and the identity or non-identity of a number of them. Among the many alkaloids, acids and bases that have been derived from the Solanaceæ may be mentioned atropin, tropin, atropic acid, tropic acid, hyoscin, hyoscic acid, duboisin, homatropin, oxytropin, scopolamin, daturin, scopolin, oscin and atrosin.

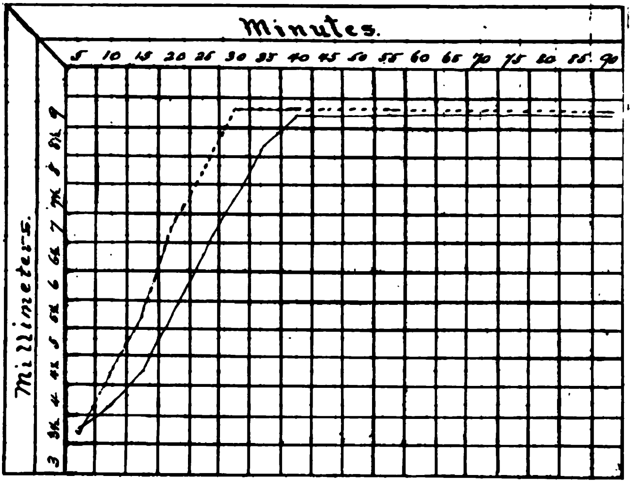

Fig. 4.—Effect on pupil.

One stands bewildered at the multiplicity and seeming interchangeability of the various bases and salts, and this confusion was not a little confounded when hyoscin hydrobromid was made official in the third edition of the German Pharmacopeia and the same chemical was designated as scopolamin (by the influence of E. Schmidt) in the 1895 supplement to the same.

Pinner[2] makes the following statements concerning the chemistry of this alkaloid family:

1. The different members of the Solonaceæ, namely, atropa, hyoscyamus, datura, mandragora, solanum and anisodus, contain two principal alkaloids, one of the composition of $C_{17}H_{23}NO_3$, the other of the composition $C_{17}H_{21}NO_4$, so that the second may be viewed as an oxidation product of the first.

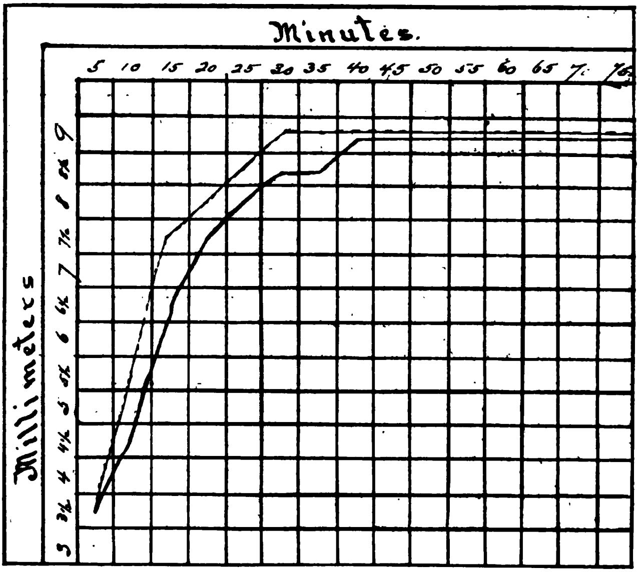

Fig. 5.—Effect on pupil.

2. The first mentioned is hyoscyamin, which is easily convertible by alkalies into atropin. While the latter principle may exist as such in small quantities in the above-mentioned species, it is altogether possible that hyoscyamin is the form the alkaloid takes in the living plant, while atropin is the form in which it appears in the dead plant.

3. The second base is hyoscin, or what amounts to the same thing—scopolamin. It would appear that in the presence of

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[2] Centrbl. f. praktiscne Augenheilkunde, January, 1893.

alkalies, hyoscin undergoes a change similar to that of hyoscyamin, and then becomes inactive atroscin.

4. Further, hyoscyamin and atropin by separation of a molecule of water, become apo-atropin or atropamin, which is isomeric with belladonnin.

5. Hyoscin is derived principally from the root of scopolia atropoides, and contains in addition to hyoscin, inactive atroscin and traces of hyoscyamin and atropin.

6. Finally, there is present in duboisin, not only hyoscyamin, but also hyoscin and other alkaloids.

The 1900 edition of the U. S. Pharmacopeia affords no help in the attempt to clear up the question. For both hyoscin and scopolamin hydrobromid it gives the formula $HBrC_{17}H_{21}NO_4 + 3(H_2O) = 434.92$.

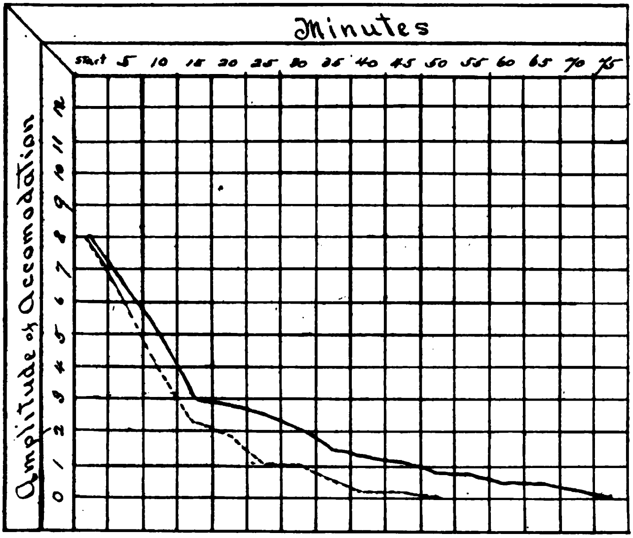

Fig. 6.—Effect on accommodation; Miss M., aged 26.

Fifteen works on materia medica and therapeutics were gone through and every one of them stated in substance that hyoscin and scopolamin hydrobromid were identical of composition and effect.

As Merck's chemicals had been used in the experiments, the firm of Merck & Co. in New York City were then appealed to and they wrote as follows:

Referring to your favor of the 9th instant, we would say that the formulas for hyoscin hydrobromid and scopolamin hydrobromid are alike as stated in the U. S. Pharmacopeia for

1900. This view of chemical identity seems to be pretty generally accepted now, although ten years ago the question was very unsettled. It occurs to us that the difference in the strength of hyoscin hydrobromid and scopolamin hydrobromid, which you noticed in your experiments, may be due in part to the fact that some makes of scopolamin hydrobromid on the market are of comparatively low specific rotatory power, and it has been held that the higher the specific rotatory power, the greater the physiologic effect of the product. For instance, the specific rotatory power of scopolamin hydrobromid (Merck) is about —20 degrees, whereas that of another make tested only about —6 degrees, and our works report that some brands test as low even as —2 degrees.

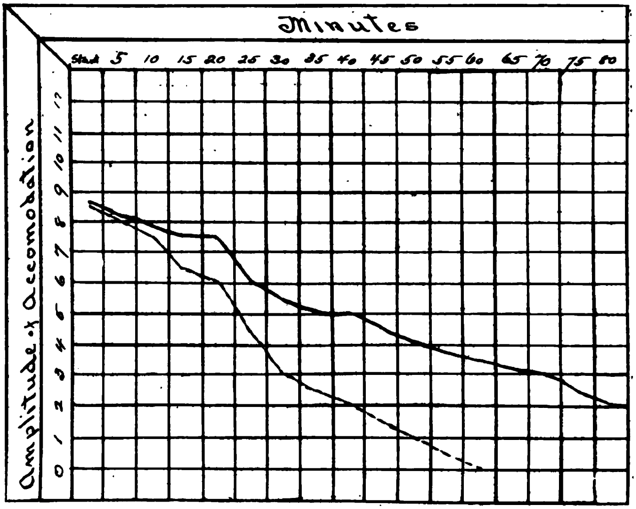

Fig. 7.—Effect on accommodation; Miss C., aged 22.

As this did not entirely satisfy the conditions under which the experiments were made, Merck & Co. were again written to the effect that the hyoscin and scopolamin salts used in the test were both of their own manufacture and the specific rotatory power of hyoscin hydrobromid was asked for. Merck & Co. again replied, stating this time that scopolamin hydrobromid (Merck) and hyoscin hydrobromid (Merck) were both of a specific rotary power of —20 degrees.

This leaves the matter precisely where it was in the beginning, namely: that with two drugs said to be absolutely identical as to clinical effect, pharmacodyamic power, molecular build and reaction with the polariscope, there should seem to be a more or less uniform difference in potency when tested by the delicate accommodation reaction.[3]

There remains as a possible explanation the parallel fact of chemical identity but pharmacodyamic difference in the effect of caffein and thein [both of the formula $C_8H_{10}N_4O_2(C_2H_4O_2)_2$], also of cocain and stovain, which are said to be chemical isomers and yet exhibit wide difference in their action. The familiar example of the kaleidoscope naturally occurs to one pondering such problems. Although the number of pieces of glass in the instrument never changes, yet how varied the changes in the effect to be had by rotating the instrument. It requires but a slight stretch of the imagination to believe that some such similar principle may be operative among chemical isomers. That is to say that, although they may be of the same total molecular constitution, yet a different arrangement of the various molecules may result in difference of therapeutic effect or biologic reac-

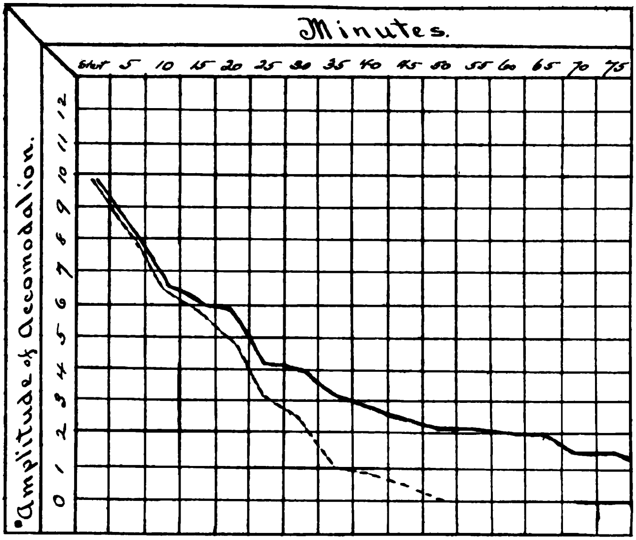

Fig. 8.—Effect on accommodation; W. J., aged 20.

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[3] Incidentally it might be noted that in Merck's price list for October, 1906, under the price given for hyoscin hydrobromid, appears the statement that "Hyoscin (Merck) and its preparations are all obtained from hyoscyamus and not from scopolia."

tion, just as one dozen dry or wet batteries produce currents of varying qualities according to the way in which they are connected, a fact utilized by electricians every day.

Unless some such possible explanation as that just offered exists there is no means of explaining the seeming difference in the reaction of the eye to hyoscin and scopolamin hydrobromid.

CLINICAL CONSIDERATIONS.

In the last analysis it is always the clinical phase of such studies that interests us most. Just how and where shall we use the facts resulting from the laboratory investigation; that is to say, the pharmacodynamic and the chemical study of these drugs?

It is probable that there is to-day no subject in ophthalmic science on which there is more diversity of opinion than that of which is the cycloplegic that stands for maximum of effect and minimum or irritation to the eye, minimum inconvenience to the patient and surgeon, and minimum period of incapacity to the patient. This would be opening up the whole question of the various mydriatics and their various methods of use by different workers, which is not my desire. Suffice it to say that semi-occasionally I use homatropin and infrequently I use atropin. In the last six years, however, in somethink like 2,000 cases of refraction in private work I have used a 1/10 per cent. solution of hyoscin hydrobromate (½ gr. to the oz.), containing cocain also in the strength of 1/5 per cent., and not once have I seen a pronounced toxemia, by which I mean sufficient inconvenience of the patient to make them too uncomfortable to go home. In about one case in fifty there is rather marked flushing of the face, quickening of the pulse and some slight vertigo, not more, however, than I have seen a number of times with homatropin. This was in all probability due to the fact that the patient did not follow the instructions about pressing over the canaliculi five minutes after the drug was instilled. Neglect of this precaution invites toxemia with whatsoever mydriatic is used. The hyoscin has been used quite as freely in little children as in adults and never have I seen a pronounced general reaction in these little ones. It is my custom to have the patient have the solution instilled once or twice the evening before and twice the morning of the consultation. This is sometimes reinforced by another drop after the patient reaches the office. For office instillation the use of the solution is preceded five minutes by one drop of a 2 per cent. cocain solution, which is always warmed, as are the hyoscin drops also. Two such hyoscin instillations are made half an hour apart, and in any time one to two hours after the first instillation the patient may be satisfactorily tested for errors of refraction in the vast majority of cases. A very small percentage (not more than 1 per cent. to 2 per cent.) will thus show that they need atropin. Accommodation sufficient for the purposes of all but the most exacting near work is generally re-established by the end of 48 to 60 hours. That is to say, that if a patient is measured on Saturday they may use their eyes somewhat for near work on Monday and pretty much as they are usually accustomed to on Tuesday. There are those who like to give their patients a weak eserin solution to hasten the return of accommodation. but except under dire pressure I dislike exceedingly to do this because of my belief that much of the precious therapeutic action of the cycloplegia is thus done away with. Few patients are as busy or pressed for time as they think they are, and if the facts concerning their eyes are rightfully and tactfully put before them there are few who will not abide by their ophthalmic counselor's advice. It is almost needless to say that I would be delighted to report every eye-strain patient's eyes under atropin because of its twofold action of complete cycloplegia and perfect rest to all the internal ocular structures. But as the tension of life in this year of grace 1907 makes it impossible to realize this ideal the search must be for the next best thing, and that, in my humble estimation, is to be found either in scopolamin hydrobromid in 1/10 per cent. solution, or, as I prefer, hyoscin hydrobromid in 1/10 per cent. solution.

It is always a matter for regret to have to admit that the number of cases submitted to experiment is so small as to leave room for doubt as to the accuracy of the conclusions drawn from the work. The foregoing work is, in a sense, open to this criticism, and yet cases suitable for this kind of experiment do not occur frequently, and even when found such patients are frequently unwilling to submit to the inconvenience of a repeated mydriasis, no matter how valuable the data that might issue therefrom. The claim is, therefore, made that the results herein set forth are entitled to consideration and may be accepted as working results until such time as some other worker by a larger series of cases may be in a position to rise and disprove them.

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A PARABOLIC REFLECTOR FOR THE ILLUMINATION OF TEST-TYPES.*

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CHICAGO.

Under present-day considerations it is imperative that artificial illumination be used for the lighting of test-types. The quality of the light produced, its location and distribution with reference to its proper reflection, are matters which have to be observed in order to obtain an even and constant illumination over the whole surface of the card. The ideal condition, that of daylight, which we should endeavor to imitate, is one of nearly perfect diffusion. An even illumination over the whole surface of the test-type card, approximating daylight, can only be obtained with artificial lighting by means of a proper reflecting surface. The most common fault with the lighting of test-types is the improper care in the selection of the reflector and the position of the lamps. The reflector has been installed and selected in a haphazard way, and the resulting illumination left to be what it may. As a consequence, with installations of this kind there are spots and streaks of light on the surface of the card, plainly indicating the location of the lamps, and the obvious difference of intensity on the portions of the card farthest removed from the light source. Believing that some attempt ought to be made to design a reflector based on exact scientific principles, so as to give uniform illumination under a simple law, the following problem was undertaken. The principle involved is the reflection from a paraboloid of revolution, viz., a beam of parallel rays falling on a paraboloid or light emanating from the focus of the paraboloid is reflected by the paraboloid as a beam of parallel rays. It is to be remembered that only when the luminous object at the focus is a point will rays diverging from it be reflected in a parallel beam. The nearest approach to parallelism occurs with the incandescent light, in which case the illuminated surface is very small. As a basis for calculation, one must first determine the point on a plane surface where the illumination is a maximum from the law, that the illumination of a plane surface by a luminous point varies directly as the cosine of the angle of incidence of the rays and inversely as the square of the distance of the luminous point from the surface.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

Let P (Fig. 1) be the luminous point, at a distance *a* above the surface AD. To find the point B where the illumination is a maximum. By above law,

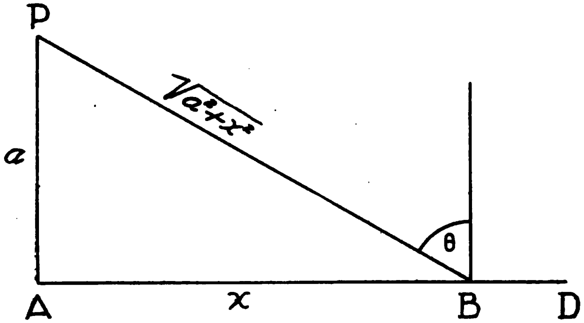

Fig. 1.—Diagram showing illustration of a plane by a luminous point.

Ill. $= K \frac{x}{(a^2+x^2)^{3/2}}$ where K is some constant.

Let $u = \frac{Kx}{(a^2+x^2)^{3/2}}$

For maximum value $\frac{du}{dx} = 0,$

$$\frac{du}{dx} = K\frac{(a^2+x^2)^{3/2} - 3/2x(a^2+x^2)^{1/2}(2x)}{(a^2+x^2)^3} = 0,$$

$$\text{or } K\frac{a^2+x^2-3x^2}{(a^2+x^2)^{5/2}} = 0,$$

$$\therefore x = \frac{1}{\sqrt{2}}a. \quad (1)$$

Let AC = 2.5 ft. (average length (Fig. 2) of card in use). Make AD = 3.25 ft. The value is arbitrary, but found to be the best value, as the longer CD is, the greater would be the length of BF. The value of CD was taken as small as possible and still have the card AC in full view of the patient's eye. Substituting the values of x and a in (1), we have:

$DF = \frac{1}{\sqrt{2}}$ (AD) = 2.31 feet. The light is to be placed at F which is to be the focus of the parabola.

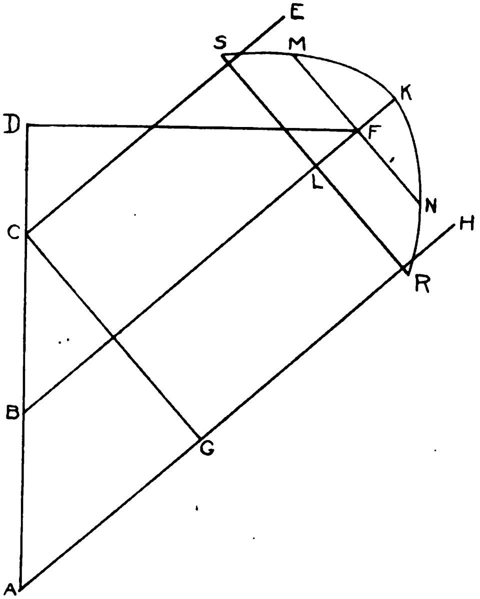

Fig. 2.—AC, card; SKR, reflector. Scale ¾ in = 1 foot.

Let FK = 1/3 ft., then FM = 2/3 ft. (law of a parabola).

By experimenting it was found that the best distance for FK, the distance from the focus to the vertex, was 4 inches, or 1/3 ft. If FK were much smaller, then the width of the reflector would be too small, and a larger value of FK would make the width unnecessarily large.

$y^2 = 4px$ (the parabola).

Therefore $4/9 = 4p\ (1/3)$, therefore $4p = 4/3$ and $y^2 = 4/3x$, is the equation of the parabola with focus at F.

The width of the parabola must be as great as CG and from similar triangles ACG and DBF, the value of CG = SR is found to be 1.9 ft., or approximately 2 ft. From the equation of the parabola $y^2 = 4/3x$, when $y = 1$, $x = 3/4$, that is KL = 3/4 ft. and FL = 5/12 ft. The focus is (1/3, 0), and LK = 3/4 ft., and LS = 1 foot.

Having determined on the kind of reflector and the illuminant, the next step in the problem is to find the distribution curve, in order properly to place the reflector so as to secure uniform illumination on the test-card. To the kindness of Mr. J. R. Cravath, an illuminating engineer, I am indebted for the following data with reference to the light distribution from an ordinary commercial parabolic reflector, using an incandescent lamp: The curve in Fig. 3 is Fig. 16 B, taken from a paper on "Data on Indoor Illumination," by Mr. J. E. Woodell.[1] This gives a photometric curve, showing the light distribution about one of the common parabolic reflectors known as the "D'Olier," No. 35. The reflector constructed on the foregoing calculations will not give a distribution of light similar to this in all planes, but it is safe to assume that in a plane at right angles to its axis the distribution of light is somewhat similar to that obtained from the D'Olier reflector shown in Fig. 3.

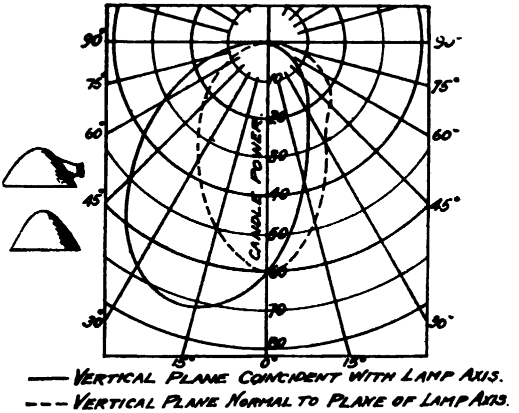

Fig. 3.—Photometric curve showing light distribution about one of the common parabolic reflectors known as the "D'Olier" No. 35.

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[1] Read at the October, 1906, meeting of the Illuminating Engineering Society.

In order properly to understand the theory of placing reflectors so as to secure an even illumination of test-cards, take an example, using the photometric test shown in Fig. 3. The dotted curved line which gives the distribution of light in a vertical plane at right angles to the lamp axis comes nearest to representing the conditions with the reflector constructed. The characteristic of this reflector, as well as of many other concentrating reflectors, is that the maximum candle power is obtained directly underneath the lamp when the lower edge of the reflector is placed in a horizontal position. The candle power rapidly falling off as the angle from the vertical increases.

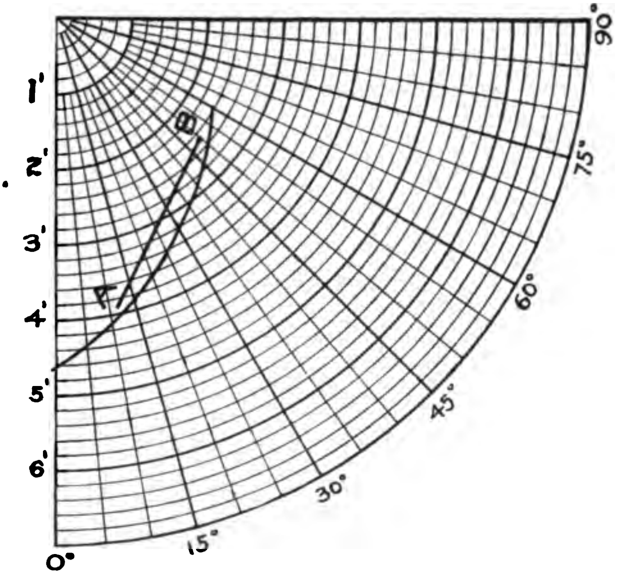

Fig. 4.—Curve showing distances in feet at which an equal illumination in foot candles would be produced by a "D'Olier" parabolic reflector. AB is proper position of card. Scale ½ inch = 1 foot.

This fact is of very great value in enabling us to place reflectors so as to illuminate test-cards and pictures evenly. It is of the utmost importance to have a uniform illumination over the entire surface of the test-card, because if the top is more highly illuminated than the bottom there is a possibility that it will affect the acuity of vision. In fact, if the top of the card is more brightly illuminated than the lower part, the lower part seems dark by contrast, even though the illumination on the lower part might be ample if the brightly illuminated upper part were not in view. Taking now the photometric curve of the reflector, as shown in Fig. 3, the problem is to determine the position in which to place the reflector so as to illuminate the test-card uniformly, and at the same time have it in a position where it will not be between the patient and the card, and also where the light will not shine in the patient's eyes. This can easily be done, for the reason that the illumination on any surface is according to the formula $I=\frac{cp}{d^2}$ where I equals the illumination on the surface in foot candles, *cp* equals the candle power of the ray, and *d* equals the distance of the surface from the source of light. Now it will be apparent at a glance that the lamp in such a reflector can be so placed with reference to a test-card that the rays of maximum intensity from the reflector will fall near the bottom of the card, while the rays of less intensity will fall near the top, and we can thus approximate uniform illumination of the card. even though the top of it may be much nearer the source of light than the bottom.

The proper position of the source of the light with reference to the card can be determined by trial in a few seconds, but it is also interesting to work out the problem mathematically and see how nearly theory will check up with practice. To determine the proper position of the reflector by caculation, a curve of equal illumination is plotted for the reflector, as proposed by Mr. E. C. White[2] in a paper on "Application of Photometric Data to Indoor Illumination." Let us take the right-hand side of the dotted curved line in Fig. 3. Fig. 4 is a polar coördinate curve in which the distance from the center represents the distance in feet at which an even illumination in foot candles would be produced by a reflector giving a photometric curve, such as is shown in Fig. 3. The plotting of such a curve is a simple matter when we have the photometric curve as a basis, since the equal illumination curve is determined by the formula $d = \sqrt{\frac{cp}{I}}$ where *d* equals the distance in feet of the surface illuminated from the source of the light, *cp* equals the candle power of the ray, and I equals the illumination in foot candles. If I is taken as a constant quantity, then $d = \sqrt{cp}$ and the equal illumination curve represents simply the square root values of the photometric curve. Fig. 4 is plotted on a scale which gives the distances in feet from the lamp at which a uniform illumination of 3 foot candles, this value being assumed for purpose of calculation, would be obtained from the reflector shown in Fig. 3. Having this uniform illumination curve, we can at once draw in parallel to the curve the proper position or angle for the test-card. The proper position of the test-card is thus represented by the line AB in Fig. 4. As the line AB is at an angle of about 25 degrees from the vertical, and since the test-card is always hung vertical, it is to be noted that the reflector should be tipped at an angle of about 25 degrees from the horizontal, and that

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[2] Read before the October, 1906, meeting of the Illuminating Engineering Society.

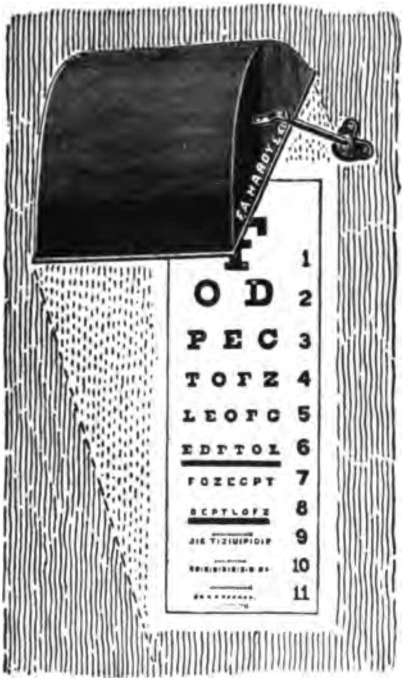

Fig. 5.—Sketch showing reflector in position on wall in its relation to test type.

the top of the test-card should be about 15 degrees below a horizontal plane passing through the lamp. This corresponds very closely to the position found to be the best with the reflector described above.

The reflector (Fig. 5) can be made of either copper, galvanized iron or tin. The reflecting surface is coated with aluminum paint, and on either side of the reflector, at the focus of the parabola, is placed an ordinary electric lamp socket. A piece of gas piping, 9/16 of an inch in diameter, with a thumb-screw attachment at the reflector end and a wall bracket at the other end, holds the reflector in place. The wires from the electric light socket are run through the piping, so as to be out of the way, and joined together with a plug for connection.

I wish to thank Messrs. F. A. Hardy and Company for their assistance in the construction of the reflector.

TREATMENT OF CHRONIC TRACHOMA.*

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SPRINGFIELD, ILL.

The original scope of this paper did not include the surgical treatment, but it has been suggested that mention be made of treatment of entropion, and such surgical measures as may be used or endorsed. This makes a broad subject—too broad to be encompassed in a short paper—and for this reason I will confine myself to what seems to me of especial merit. This will leave the subject open for discussion by those who may favor Roentgen-ray treatment, electrolysis, or other lines which may be intentionally omitted, and the omission is not made with the purpose of ignoring other methods, but because of an insufficient amount of actual experience to enable me to express a judgment which may be deemed of value.

It will be presupposed, for the sake of argument, that the disease is contagious, and if so, due to a germ. This is based on personal observation relative to the contagiousness of the disease.

GERMICIDES.

The principal considerations are: First, select a germicide which is effective; second, prepare the infected surface in such a manner that the germicide may act; third, combat corneal complications (pannus and ulcers); fourth, correct the condition of the lids, which may cause relapsing inflammation (entropion, cysts, etc.).

The remedies used are copper sulphate, mercuric oxid, tannic acid, silver nitrate, boric acid, jequirity. In the empyrical use of drugs to combat chronic trachoma, perhaps no remedies have been so extensively used as copper sulphate and silver nitrate. The former, in the absence and the latter in the presence of secretion. Of these, copper sulphate deserves special attention. It may seem almost presumptious to more than mention a remedy, the use of which is so familiar to all. My excuse for so doing is based on the following incident. A former patient came to my office and related his experience, which set me to thinking. In former years I had repeatedly treated him. Each time he would improve, but after returning home, he would relapse, until finally he found an old woman who effected a permaennt cure at the cost of a dollar.. Inquiry evolved the fact that the medicine used was in a small vial (half ounce), and that he was told to dilute one drop in twenty drops of water, and use it freely in the eyes several times a day. It was blue and thick, like glycerin.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic City Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

This incident might have been unimportant had not my attention been attracted about the same time to an account of experiments carried on by the United States Department of Agriculture, in the use of copper sulphate as a germicide.[1] The most spectacular experiment, and the one first brought to my notice, was that pertaining to the algæ which produce the green scum on the surface of stagnant water. A bag containing crystals of copper sulphate was hung behind a boat while it was rowed along the margin of a pond. An infinitesimally small amount of the salt was dissolved from the crystals, yet it was enough to kill the algæ.

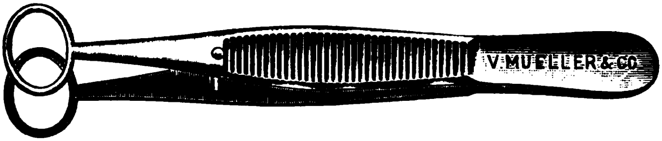

Fig. 1.—Forceps for squeezing out the contents of the follicles.

A great variety of organisms, an idea of which is given by the following list, was made the subject of these experiments.

Bacillus mycoides, *Bacillus megatherium*, *Bacillus mesentericus*, *Bacillus mesentericus fuscus*, ***Bacillus subtillis***, ***Bacillus prodigiosus***. *Bacillus liquifaciens phosphorescens*, pink yeast, ***Bacillus coli***, sulphur yellow bacillus, ***Pseudomonas radicola*** (soy), ***Bacillus sublanatus***, *Micrococcus radians*, ***Pseudomonas radicicola*** (alfalfa). *Bacillus violoceus laurentius*, ***Pseudomonas amethystina***, ***Bacillus*** *caudatus*, *Bacillus rubrum*.

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[1] Bull. 76, Bureau of Plant Industry; Copper as an Algicide; also Bull. 100. The Effect of Copper on Water Bacteria.

The exhaustive nature of the research and the manner of exhibiting the results are illustrated by the accompanying table pertaining to *Streptococcus pyogenes.*

From the above table, it will be seen that the solution of copper is diluted 1:1,000, 1:10,000, 1:25,000, and so on to 1:1,000,000, as exhibited in the top row. The solution containing the germs under investigation were exposed for periods ranging from two hours to twenty-four hours, as indicated in the vertical column on the left hand. In this manner it is shown that copper sulphate, in dilution 1:25,000, destroyed every germ in less than two hours. Similarly, *Bacillus coli* was destroyed in dilution 1:1,000,000 in six hours.

Thinking along this line, it occurred to me that the remedy referred to by my country patient was probably nothing more nor less than a solution of copper sulphate in glycerin, and that I was led to wonder whether we had not been mistaken. Regarding the method of using this remedy to get the surest results: In place of the application of the crayon or crystal to the lids by the physician once a day or less often, might it not be better to make a solution and put it in the hands of the patient, and have it used frequently. My former efforts to get a stable solution had not resulted in a success, and it may be that others have had a similar experience.

EFFECT OF COPPER SULPHATE ON STREPTOCOCCUS PYOGENES.

Hours of Exposure.	Check. Colonies.	1 part copper sulphate to—					
		10,000 parts of water. Colonies.	25,000 parts of water. Colonies.	50,000 parts of water. Colonies.	100,000 parts of water. Colonies.	500,000 parts of water. Colonies.	1,000,000 parts of water. Colonies.
0	180	875	875	300	250	90	180
2	210	0	0	290	180	180	180
6	140	0	0	280	230	240	160
24	35	0	0	390	150	10	20

Copper sulphate is so prone to decompose by oxidation that an aqueous solution soon loses its activity. After some experiments I made up a pint of 10 per cent. solution in glycerin, in which the salt was found to dissolve readily, and filled a number of two-dram vials and placed the following label on each: "Dilute one drop in twenty drops of water. Use freely in eyes four times a day. Increase strength; make fresh each time."

One of these bottles was given to each trachoma patient then under treatment, and this was continued during the subsequent months. It was found that it was well to commence with one drop in twenty drops of water, and use it four to six times a day. The patient was told to decrease the water as he found he could tolerate it, or increase it if it proved too irritating. Increased toleration was observed. Some patients would not complain, and rapidly increased to 1:5 or stronger; others complained of irritation lasting some hours. A few complained of a solution of 1:40, but subsequently tolerated it stronger. Some did not tolerate it well, and it was discontinued. In the main, however, it worked well and dozens of patients seem to have been permanently cured by the remedy.

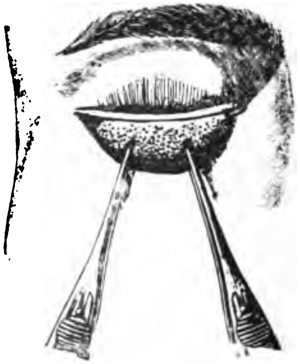

Fig. 2.—Excision of the tarsus, first act. Eversion of the upper lid with forceps (Kuhnt).

One of the first cases in which I used the remedy in this manner was that of Miss H. The granulations had been squeezed out, and the lids were cicatrized and smooth. Yet she would occasionally develop trachomatous ulcers. These yielded best to the thermo-cautery. She always did well on copper stick, which she learned to use, and when she felt the irritation she would resort to the remedy. On this occasion the ulcer had got a start and was not responding well to treatment. She went home, a distance of fifteen miles, with a vial of 10 per cent. solution of copper sulphate, with directions to use it, and return in two days. She did not return for three weeks. When she came I was surprised. The eyes were wide open, the ulcer healed, and the lids were free from congestion. The remedy proved so grateful to her that she had divided the medicine with neighbors who had trachoma, and they all wanted the prescription, so well had it acted.

I guarded the prescription, preferring to dispense the medicine in order to keep the patient under observation. In this manner I have been able to observe a large number of cases; have inquired of each patient about the result, and their reports with few exceptions, are quite uniform. In only a few cases there was a complaint of hazy vision for an hour after treatment.

On the whole, it is my opinion that this is the best home medical treatment that has come to my notice, and it is recommended that it be given a trial, under the belief that the frequent instillation into the eye of a fresh solution, made up from a stable solution in glycerin, is more efficient than the occasional application of the bluestone crystal.

TANNIC ACID AND MERCURY OXID OINTMENT.

Two other favorite remedies in past years have been glycerole of tannin, 4 per cent., and yellow oxid of mercury.

After investigating a score or more of remedies during the lapse of years, a few months' use of each has usually resulted in returning to the use of tannin and mercury oxid ointment, 1½ per cent., which resumes popularity after each new candidate for honors has been found wanting. They have the advantage of being almost universally tolerated. Even now, after dispensing with tannin for a year in favor of the above copper formula, I find myself writing prescriptions for the old friend, and adding some sulphate of copper for a companion.

Similarly, tincture of iodin and phenol may be incorporated with effect, but nothing, in my present frame of mind, equals the old lady's cure for a dollar.

SILVER.

In conjunction with the above, a condition is found which indicated the use of silver. Like copper, it is deemed desirable to prescribe the remedy in such form that the patient may use it without harm, or without being discouraged by too much irritation. To meet this, it is usually employed in the office, or used at home in ½ per cent. solution once a day, preferably a short time before retiring.

In the presence of muco-purulent secretion nothing else seems to serve the purpose so well, and the drug is usually ordered in conjunction with one of the other remedies used during the day.

PREPARATION OF THE LIDS TO INCREASE THE EFFICIENCY.

Having selected a drug, of no less importance is the removal of trachomatous material which might prevent the remedy from reaching deeply situated infection. It may be remembered that Mandelstamm of Russia was the first to call attention to the squeezing out of the follicles. This was done by pressing the inverted upper lid against the thumb nail. His article appeared in German, and was presented to the English reader first by Dr. F. C. Hotz. It fell to my lot to first realize the importance of having a special instrument for squeezing out the contents of the follicles. The accompanying cut (Fig. 1) illustrates the first forceps used for this purpose, which is so simple that instrument makers have not succeeded in destroying its usefulness, as is often done by various modifications designed to cheapen them.

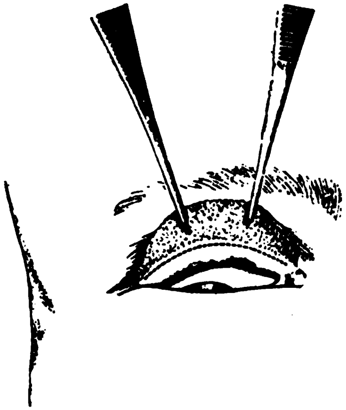

Fig. 3.—Second act. Complete eversion of the inverted upper lid and exposure of the retrotarsal folds. First incision along the dotted line (Kuhnt).

The instrument of Dr. Herman Knapp, known as the "roller forceps," is too well known to need comment. The great object is to get one blade well back into the retrotarsal fold, and express the trachomatous material.

The instrument illustrated above has superior advantages when it is found necessary to reach into the angles, especially about the vicinity of the caruncle. Bleeding bears an important share in creating the immediate benefit that so often attends the operation of squeezing. All agree that thoroughness is the greatest desideratum connected with the removal of trachomatous material.

ANESTHESIA.

It is my ususal practice to administer chloroform in conditions of active inflammation, and cocain in those cases presenting no particular irritation at the time. Ethyl chlorid furnishes a good substitute for chloroform, if properly administered, accomplishes the purpose admirably. In using cocain it has been found best to inject it hypodermically under the conjunctiva of the retrotarsal folds. It is advantageous to add 10 per cent. of 1:1,000 adrenalin chlorid solution, which diminishes the bleeding and increases the efficacy of the cocain. In the non-inflammatory types, a roll of cotton may be moistened with a 10 per cent. solution of cocain in 1:15,000 adrenalin, and inserted into the retrotarsal folds. After ten minutes the anesthesia is almost complete.

After squeezing, scarifying and milking out all the trachomatous material, apply a 10 per cent. solution of copper sulphate in glycerin, and scrub with cotton, so as to force it into the tissues. Rinse with water to remove excess, and prevent corneal irritation. A Belgian method which has been popular in the army, has been the rubbing on with the finger of powdered boric acid.

One of the errors of ophthalmologists in handling trachoma has been that of placing too much reliance on the operation, and not following it up with some remedy which would attack the disease after having exposed it.

COMPLICATIONS OF TRACHOMA.

The principal complications of trachoma are ulceration of the cornea and pannus.

Ulceration of the Cornea.—With the consideration of this condition it is pertinent to say a few words concerning the treatment. Ulcers occurring in conjunction with trachoma show little tendency to heal until the trachomatous infection has been brought under control by the germicidal action of the blood, chemical remedies, or actual cautery.

Following this, a healing tendency is usually rapidly established; pannus proceeds and nutrition follows. The favorite cautery in these cases is the Gruening platinum probe, which is heated in the Bunson flame, and applied to the entire area. When the necrosis is shallow, rapid recovery usually follows, but when the layers of the cornea are destroyed down to the membrane of Descemet, it is usually found necessary to make a paracentesis through the floor of the ulcer, and keep the opening from closing by the repeated application of a probe until the healing tendency has been established. The establishing of a fistula by cauterizing the margin of a perforating ulcer will often bring about a rapid change from a progressive destruction to rapid reparation.

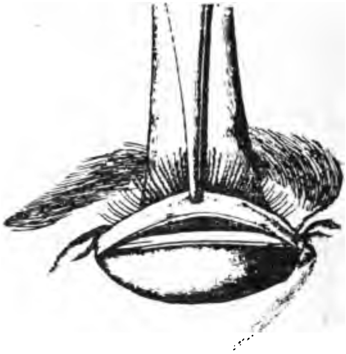

Fig. 4.—First act in the operation for removal of the tarsus without sacrifice of the fairly healthy conjunctiva (Kuhnt).

As an aid to repair iodoform has held first place, but argyrol in 25 per cent. solution every two hours is well tolerated, painless and efficient.

Hypopion, in conjunction with trachoma, is similarly treated. It is the aim to divide the floor of the ulcer and carry the incision into the sound tissue on both sides. The pus escapes with the aqueous humor, and the anterior chamber is emptied twice daily with a probe, when found necessary, until no more pus is formed, after which the opening in the cornea is allowed to heal.

In the case of large superficial ulcers, it is at times found necessary to apply salicylic acid, 10 per cent., in alcohol, to the entire surface. Another remedy which acts admirably, is monochloracetic or trichloracetic acid, in saturated solution. The eschar is scraped off and a second application applied until the entire necrotic material has been removed. Following this, the healing will often proceed rapidly. Great care and judgment must be exercised in handling the above remedies.

In cases of sluggish and obstinate extension of an ulcerated area, I occasionally resort to hot physiologic salt solution, applied with an eye bath. The bath is applied, the head raised and the eye opened. The patient is required to repeat this as hot as can be borne, for fifteen minutes, four to six times a day. In the interval, ice compresses are used to reduce the temperature, and put the remaining microbes, so to speak, in cold storage. Compresses are placed on a piece of ice and changed every three minutes. In many cases it is believed that eyes have been rescued, which would formerly have been thought hopeless. Internal administration of strychnin, manganese and iron are employed to aid in counteracting a sluggish circulation, which is the greatest menace to the integrity of an ulcerating cornea. So soon as pannus is seen at the margin of the corneal ulcer, recovery is in sight.

Much more might be said concerning the treatment of ulcers, but since they may occur in the absence of trachoma, further consideration is unnecessary.

Pannus.—Chronic pannus is one of the most obstinate complications one meets, and it deserves especial consideration. Many of us remember the occasional use of the gonorrheal virus from ophthalmia neonatorum, which was occasionally employed in cases on inveterate pannus from trachoma. As a student, this was impressed on me by the story of Dr. E. Williams of Cincinnati, which was re-told to every class for a number of years, and which should have a place in history. He used to tell of a case that had defied all kinds of treatment, and the patient had become almost blind from pannus crassus. The physician, as a *dernier ressort,* explained to his patient that he had one remedy left, which might destroy the eye, but if it did not, restoration of vision might result.

The ultimatum was accepted. In the wards of the hospital a new-born babe was found to furnish the infection, and a minute quantity of the virus was introduced into the eye. Violent inflammation was set up, ran its course, and ultimate recovery was the result. The grateful patient begged the doctor from time to time to tell him the name of the wonderful remedy, and finally he was made to swear an oath never to divulge it to any living mortal, and after being duly impressed, the fact was imparted to him that the remedy in question was "glandola." The climax of the story came in a letter which eulogized Dr. Williams for his skill, and the knowledge of a remedy unknown to the druggists and doctors of the times, finishing with the doggerel:

> "But, however that may be,
> I once was blind, and now I see;
> 'Glandola' did the work for me."

It did not fall to my lot to see this remedy employed, but its use was not extremely rare in the clinics of Europe at an early period.

JEQUIRITY.

The death knell of the employment of gonorrheal virus was sounded when the discovery of jequirity was announced to the world by the eminent De Wecker of Paris, whose popularity caused a wave of enthusiasm over the new remedy to spread over the world scarcely less rapidly than that of cocain and the Roentgen-ray. Unlike the history of cocain the popularity of jequirity met with a sudden reversal, and an ebb tide of condemnation recoiled with such vigor as to almost sweep the remedy into oblivion.

It may serve a purpose here to relate how a wealthy citizen of Rio de Janeiro suffered from trachoma and pannus; how he made a trip to Paris; how he improved under the copper crystal treatment, and how he relapsed after returning home. A second and a third time he came and returned improved, but not cured. At last, when in despair, he heard of a tribe of Indians in a remote region, who had a remedy. In desperation he made the trip, submitted one eye to the medicine man, who made an infusion of the bean *Abrus precatorius*, moistened a compress, and applied it to the eye. The result was a fulminating inflammation such as is familiar to most of us, but which quickly subsided, with the happiest of results. A similar treatment of the second eye followed, with the same result. An account of this experience was sent to De Wecker, together with a sufficient number of the beans, and observations were commenced. Every phase of trachoma, and in fact every type of conjunctivitis and corneal inflammation was subjected to the remedy. The old chronics who filled the clinic for a daily dose of silver or copper were, in most instances cleared up, so to speak, and ulcers and pannus were seen to yield in a manner and with such promptness as had never been seen before. The first publication from DeWecker on the subject was copied, and in a year the use of jequirity was almost universal. The recommendation was so indiscriminate that but one result could follow. Almost as rapidly as confidence was established, it was shaken by adverse reports. The loss of eyes was reported, and it was soon regarded as too hazardous a remedy to use except as a last resort, and it found its place in the same category as infection from the gonococcus.

The adverse criticism was so definite that one had poor defense in case of a malpractice suit for producing an inflammation of such a type as that which resulted from jequirity. During the following decade the remedy was comparatively little used. Seldom in the history of medicine has such a popular wave of enthusiasm been followed by almost as complete and rapid a discontinuance of the use of the remedy.

Taken in its entirety, the decision both *pro* and *con* was a grave mistake. First, the remedy was rushed before the profession before it was fully tried out. Ulcers of great variety of types were seen to yield under the influence of the drug, and it happened that the cornea did not suffer in the first hundred of cases in which it was tried. The want of caution that this produced led to the loss of the eyes in a great many cases in which the primary disease for which it was used lacked sufficient seriousness to justfy taking the risk. Besides, it was found that the solution in plain water was a good culture medium for a large variety of micro-organisms. In a few days, and before the characteristic membrane was produced, the solution was usually teeming with micro-organism, which, although usually non-pathogenic, were occasionally a source of infection to the cornea.

In this connection I desire to add my influence to cause the pendulum to swing in the other direction. The introduction of jequirity found me practicing in a community which abounded with neglected trachoma. It was my fortune to use jequirity in solutions of sublimate and boric acid, and during a period of twenty years confidence in the remedy has never been shaken. It was my fortune not to have any serious complications before learning of the contra-indications, and it was also my fortune to commence the use of the remedy in a form much more diluted than originally advocated. For this reason the remedy preserved its popularity and brought numerous cases of pannused cornea under its influence.

The operation of this remedy may be illustrated by the case of a young woman who was almost totally blind with pannus crassus. So opaque was the pannus that the outlines of the pupil were not discernible. She was carried through three courses of jequirity; the recovery from each of which let in more light, until she could see her way. Transparency increased with the months, until she could read, and eventually no one would have suspected that she had ever been blind from pannus crassus.

Another case which is recalled was that of a young man who had recurrent superficial ulcers and ever-present irritation and pannus for a period of two years, during which time he had been under the care of the most eminent oculist of the west, whom I have ever honored as a cyclopedia of ophthalmic wisdom.

Imagine the patient's skepticism at the suggestion of a cure in thirty days. One course of jequirity caused a thrombosis and atrophy of all the vessels and left him with a clear cornea. In less than half the time suggested he was discharged and he has never had a relapse.

From the above it may be easily inferred that I am an advocate of the remedy, and I take this opportunity to endorse it, and at the same time, comment on the manner of its use. It is often the case that a remedy falls into disuse because of an unwise method of administration, and I think that is the case with jequirity.

Reference to the literature reveals the fact that it was almost always used in solution of 3 or 4 per cent. and stronger. This strength causes a rapid infiltration of the lids and cornea. The pain is intolerable. Local applications do not relieve it, and morphin is required. The rapid infiltration does more; it endangers the nutrition of the cornea. A superficial sloughing takes place, and general infection following, may lead to the results which led to the abandonment of its use.

At the time of its introduction, and ever since, I have had my patients directly under my personal control, and could see them at once in case of any untoward symptom. This led me to suspend the treatment on the development of severe pain, and the early adoption of the plan of commencing with a very weak solution, one-fourth of 1 per cent. This is employed twice a day for two days, during which time the tissues stretch to accommodate the infiltration. In case the eye is sensitive to the remedy, a solution of this strength is usually sufficient to produce the desired reaction. In case toleration exists the strength of the solution may be increased to one-half or to 1 per cent. The eye soon develops tolerance, and commences to improve before the discontinuance of the use of the remedy. It is desirable to secure a decided membrane covering the surface of the tarsal conjunctiva. It may extend over the retrotarsal fold, in which case care will be necessary to separate the surfaces which lie in contact or adhesion may take place.

A word concerning the preparation may not be out of place. It will be found very difficult to remove the cortex of the bean, and reduce it to a powder unless one is provided with the proper means. The suggestion is to get a hand pepper grinder, with which many persons grind pepper fresh while at table. The first turn breaks the cortex. The beans are emptied out, the cortex removed, and the kernel replaced in the grinder. They are ground through several times until a moderately fine powder results. Divide into one grain powders. One powder in two drams of a 2 per cent. solution of boric acid will be the initiative dose. It is ready for use in fifteen minutes, and should be made fresh every day.

JEQUIRITOL.

After falling almost completely into disuse, even in the large hospitals and dispensaries, a revival of the remedy has recently taken place in the preparation known as *"Jequiritol."* It is sold in vials containing a solution of abrin, in definite strength. Also a serum to control its action. The writer has no experience with jequiritol, but the results reported are similar, although not better than those experienced from the use of jequirity. The remedy has been tried at the Illinois Charitable Eye and Ear Infirmary, and I have asked Dr. Beard, Dr. Dodd and Dr. Woodruff, if present at this meeting, to discuss this phase of the subject.

The following are some review notes, which will serve to place the remedy in a satisfactory manner before the Section.

JEQUIRITOL THERAPY.

E. Hummelsheim[2] reports that the jequiritol therapy of trachoma does not affect the process in the mucosa, since the granules remain unaltered. In recent pannus the results are not very good, but occasionally a very remarkable improvement will be noticed. Very good services are, however, rendered in the chronic pannus of cicatricial trachoma, and in eczematous pannus and keratitis. Old scars on the cornea will frequently yield. In all other processes of the conjunctiva or cornea the results are not so uniform, hence it may be stated that jequiritol is only indicated where nothing can be expected from other drugs. Complications are severe pain, slight fever, swelling of the pre-auricular glands, and rarely suppurative parotitis, erysipelas, iritis, and inflammation of the lachrymal apparatus.

SURGERY.

In conjunction with the treatment of chronic trachoma, there are two surgical procedures on the lids which should be practiced whenever indicated, viz., entropion and excision of the tarsus.

Entropion.—It would hardly seem necessary to mention entropion, yet there are a few points to which attention might be called with advantage. The operation which I advocate is that of Anagnastakis. This operation was practiced before that of Dr. Hotz. In my earlier operation, an attempt was made to follow the Hotz method, but by degrees I gradually reduced the size of the lower skin flap by making the incision nearer the ciliary border. An incision was made in the margin between the line of the cilial and Meibomian glands. The graft of the lid has been discontinued. The skin of the upper flap is not included in the sutures.

In a controversy with one of Dr. Hotz's students who witnessed the operation, I was led to look up the publication of the operation in Knapps Archives, and found a footnote describing exactly the operation which had been reached, while still supposing that the Hotz operation was being performed. Hotz commenced with

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[2] Ophthalmic Klinik, 1904, No. 4.

Anagnastakis and reached Hotz. I commenced with Hotz and unconsciously modified it until it was found to correspond to the description of Anagnastakis. I think the use of the graft is quite superfluous, as the wedge-shaped opening fills with exudate which organizes. I occasionally made a groove in the outer part of the tarsus, after the manner of Snellen. A canthoplasty is often indicated in case of blepharophimosis. The literature of entropion and its treatment is so replete, and so accessible in the text-book, that more than the above mention seems out of place here.

Excision of the Tarsus.—The consideration of excision of the tarsus, on the contrary, is not so well understood nor practiced, and this opportunity is taken to thank Dr. Kuntz for originating and Dr. Wood for repeatedly calling attention to this operation for finishing up the process in those chronic cases of trachoma in which the lid becomes full of infected cysts, nodules and cicatricial bands, which produce recurrent ulceration.

In these cases, the removal of the tarsus has become classic, and it is hoped that Dr. Wood, who had considerable experience with this, will enlighten the Section with his more recent experiences. Attention is also called to an article in the Ophthalmic Record on American operators. The indications for the operations which have been virtually agreed on by its advocates are the following:

1. Conditions in which the disease is not amenable to medical or surgical treatment by which the palpebral conjunctiva may be preserved. These include tarsi which show foci of trachomatous infiltration or granular deposits which cause recurrent inflammation or cysts which are not eradicated by curettement or cauterization.
2. Cicatrization which offers an irregular surface with a mucous covering, and the dryness and roughness are a menace to the corneal surface.

These conditions have defied all measures, and are ever a menace to the integrity of the cornea. It is this condition which has led operators in the past to excise the retrotarsal fold. The removal of the tarsus, together with the diseased portion of the retrotarsal fold, would seem to limit the excursion of the lid and endanger the supply of the moisture to the eyeball through obliteration of the ducts of the lachrymal glands. This is found not to be the case. In the first place, the limitation of mucous membrane is less objectionable than the presence of diseased membrane. In the second place, it is established knowledge that the lachrymal glands are not required for the supply of ordinary moisture. This is sufficiently supplied from the mucous cells and acinous glands. This fact furnishes the surgical justification for removing the lachrymal glands in cases of epiphora, where it is found impossible to establish satisfactory drainage through the naso-lachrymal duct. The operation of removing the tarsus has been developed by Kuntz, whose cuts illustrating the procedure are so clear as to require little description. The liberty is taken of reproducing them from the paper of Dr. Casey Wood.[3]

First.—The lid is everted and the convex border grasped by two catch forceps (Fig. 2).

Second.—The everted lid is then everted on itself, exposing the retrotarsal fold (Fig. 3).

Third—An incision is made beyond the line of diseased tissue separating the portion of the conjunctiva in which are placed three waxed sutures, or preferably 00 catgut sutures. One suture should be exactly opposite the middle of the margin of the lid; the other at an equal distance on either side. An incision is made through the tarsus and parallel to the lid margin, leaving the conjunctiva untouched, which may seem normal or likely to become normal (Fig. 4). The tarsus is then dissected out back to the original incision, as shown.

The cut edges are now united. The original method as published inevitably bringing the cornea in contact with the knots. This is avoided by arming each end of each suture with a needle. These are brought through the skin and secured to the outside.

The above is submitted with a consciousness that the paper is open to criticism. The subject is too large for a complete consideration.

It is hoped that my observation on copper sulphate will find verification at the hands of others. If so, the time consumed by the presentation may not be wholly wasted.

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[3] American Jour. of Ophth., July, 1903.

CONGENITAL SQUINT.*

WILLIAM CAMPBELL POSEY, M.D.

PHILADELPHIA.

Like all other phases of the muscle problem, that of which I treat in this paper can scarcely be said to be solved; indeed, it may well be doubted if a distinct discrimination is always made between this variety of strabismus and concomitant squint. It is not easy in infants and young children to detect a limitation in the movement of an eye, which is the usual diagnostic point of difference between congenital and concomitant squints, though it will be remembered that while in concomitant squint the deviation of the ocular axes persists as the eyes are moved through the different meridians of the field of fixation, the degree of the deviation remains constant, and the angle of the squint is always the same, whereas in congenital squint the degree of the deviation and the angle of the squint vary according as the eye with the defective muscle or muscles is moved in the direction supplied by those muscles.

And, again, even though the paralytic nature of the squint be detected, it is often imputed to a postnatal cause, cognizance not being taken of the fact that, though the conditions occasioning the squint may be present at birth, the actual deviation may not manifest itself until weeks or months later. For the ocular movements in all infants are at first purposeless and incoördinated, and it is only later when the eyes attempt to converge in response to the impulses of an educated center that the flaw in the mechanism becomes apparent; moreover, in deviations due to central causes, the cerebral lesions, while congenital, often require further development to occasion actual paralysis of the eye muscles.

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* This paper has been accepted by the executive committee of the Section on Ophthalmology of the American Medical Association, to be presented before the Section at the Atlantic Cit– Session, June 4-7, 1907. Publication rights reserved by the American Medical Association.

In addition, however, to the limitation of motion which is present in congenital squint, there are other ways of discriminating between it and concomitant strabismus. In the latter, as is well known, both primary and secondary deviations are equal, while in the former, though the rule is not invariable, the secondary deviation is often greater than the primary, just as is observed in cases of acquired palsy of the eye muscles.

According to Kunn, the secondary contraction which is present in acquired palsies is absent in the congenital, though it was Graefe's experience that, while this is usual, it is not invariable, and secondary contraction may be absent in acquired and present in congenital paralysis. Corresponding to this absence of contraction is the fact that there may be either no deviation in the primary position or one contrary to what would be expected. Such anomalous position of the eyes in congenital paralysis seems often, however, to be due to complications which would produce a like result if the paralyses were acquired.[1]

As other differential points in diagnosis may be mentioned the absence of involvement of the iris and ciliary body in congenital palsies, and the reaction of degeneration in the levator in acquired cases when ptosis is present.

Finally, I have often been aided in my diagnosis of congenital squint by the detection of nystagmus in this class of cases, a symptom which is usually absent in concomitant squint, and by the good vision which is frequently binocular in this variety of squint, lowered vision in one eye being, on the other hand, one of the essential features of concomitant squint.

In congenital squint there is no suppression of the image, and, though diplopia may be present at first, it is soon lost.

In congenital squint both eyes are employed at times binocularly in the parts of the field of fixation where this is possible, or monocularly and independently of one another, just as is the case in alternating strabismus.

While, when a distinct and accurate subjective orientation is required, rather than a clear perception, the normal eye, even though it possesses lessened visual acuity, is employed exclusively, it is a matter of experience that under ordinary circumstances, even in those cases where acuity of vision and the refractive state of both eyes are alike, the paretic eye is used for fixation, the normal eye appearing in secondary deviation. Indeed, Kunn has reported a few cases in which this was observed even when the vision in the paretic eye was much reduced.

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[1] Duane: The Eye and the Nervous System, edited by Posey and Spiller, p. 224.

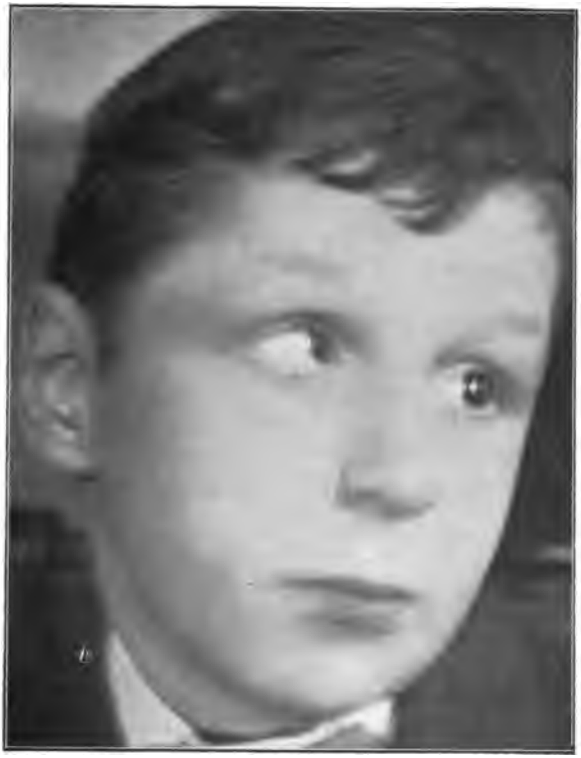

Fig. 1.—(Case 6.) Paresis of both superior and right rectus externus muscles. Showing torticollis; head held in oblique position, right side of face presenting. Gaze directed to extreme left. O. S. fixing and O. D. deviated up and in.

It must be noted, too, that the normally innervated eye may forget how to execute proper subjective orientation as a consequence of its having been held in a state of deviation, not by an effort of the will, but in conjugate relation to the paretic muscle of the fellow eye.

Of considerable moment is the persistence of secondary contraction in the antagonistic muscle even when the primary paralytic affection completely or partly retrogresses, the same cause which is active in producing secondary contractions preventing restoration to a normal condition, even when there is a probability of such restitution. Indeed, the contraction of the antagonistic muscle following paralysis may increase independently in cases where the primary paretic affection is progressing towards recovery.

By reason of this alternation in fixation of the sound and deviating eye and secondary contractions and deviations, the detection of the initial deviation is always irksome and, in conjunction with the difficulty which attends the examination of young children, renders the diagnosis of congenital palsy one of the most perplexing problems in ophthalmology.

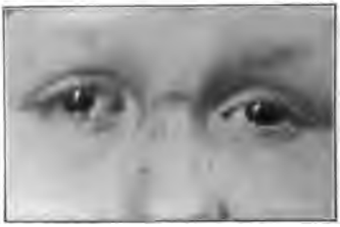

Fig. 2.—(Case 6.) Showing almost perfect parallelism of visual axes (O. D. slightly divergent) after advancement of right rectus externus and tenotomy of both inferior oblique muscles.

It is evident that the same measures which are appropriate for the detection of a faultily acting muscle or group of muscles in an adult can not be employed in young subjects; subjective tests are often impossible, and many of the objective tests impracticable. Diplopia can not be elicited and the various tests which depend on the nature of the double vision are useless. In like manner, the parallax test can not be depended on, nor can the Maddox rod be utilized. As a rule, recourse must be had to purely objective methods, chiefly in observing the movements of the eyes through the various meridians, first in binocular fixation and, secondly, in monocular, and the observer will often have an opportunity to display much ingenuity in the performance of these tests, and will be rewarded according to his patience, skill and quickness of observation.

In making the examination, all persons or objects which might serve to distract the attention of the child should be removed, and with the subject seated before a window, and with the movements of its head properly restricted by the parent or an assistant, the examiner, provided with a toy, or, as is my custom, with a small red electric light, should deftly and quickly move the

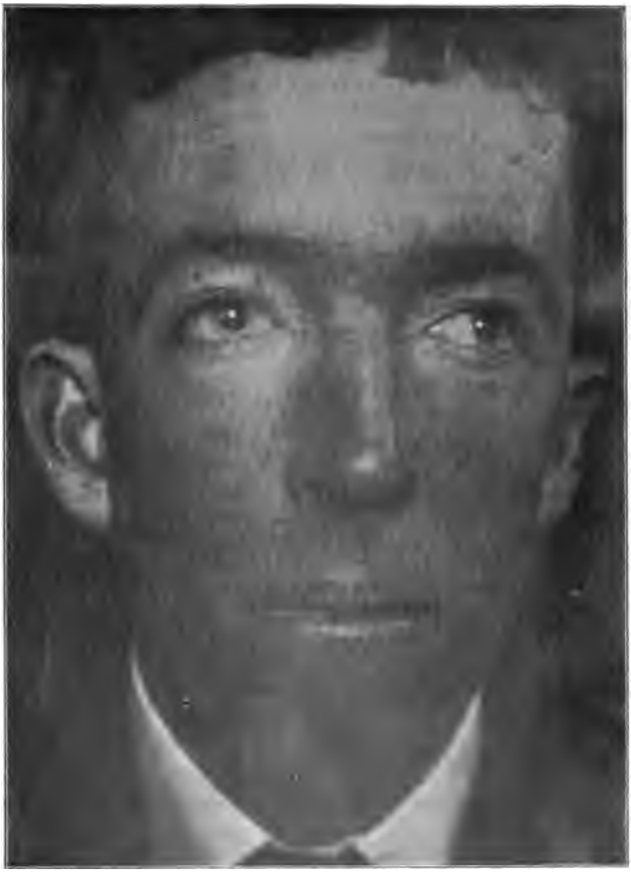

Fig. 3.—(Case 7.) Ocular palsies in twins. This and Figure 4 show underdevelopment in the facial bones; both skulls are much undersized. Fixing with O. D.; O. S. diverging about 20 degrees. Palsy of both superior recti muscles.

object through the various meridians while he notes the character of the ocular movements. After these excursions have been studied, although not feasible at times, a screen should be brought alternately before either eye, and the character of the deviation behind the screen noted, and an approximation made of the relative extent of the primary and secondary deviations. Before the head of the child is secured, a valuable hint as to the nature of the palsy may often be obtained by noting the position which the head assumes when the eyes fix the examination objects. While this method of detecting the ocular movements is often extremely unsatisfactory, and is rarely accurate or convincing, the diagnosis of the faulty muscle or group of muscles can usually be established only in this way.

Although designated by some "congenital palsy," the term "congenital squint" is to be preferred in describing the class of cases under discussion, for not all of these cases are paralytic. Briefly stated, the causes of this variety of strabismus may be either central or peripheral, the former occasioning the deformity by innervational disturbances, the latter by structural anomalies.

Among the central or innervational causes may be mentioned aplasia of the nuclei of the nerves or of the nerves themselves supplying the muscles. Wilbrand and Saenger[2] have studied the region of aplasia of the oculo-motor nucleus in a case of double congenital ptosis. The facial, abducens and trigeminal nuclei, as well as their intermedullary roots, were normal, but in the oculo-motor nucleus on the right side and especially in the large cells of the lateral nucleus there was a considerable reduction in the number of ganglion cells. The cells, however, which were present were normal, inflammatory and degenerative changes being absent, the condition being an aplasia of the oculomotor nuclei in its true sense. Aplasia of the nuclei, however, must be differentiated from the degeneration which takes place in these centers and which has been described by Möbius under the name of "infantile nuclear degeneration," and from the allied condition of degeneration of the nuclei supplying the ocular muscles which occasions the clinical syndrome designated as "chronic ophthalmoplegia externa." Palsies arising from these sources can not be said to be congenital, as they develop after birth. The differential diagnosis between these and true instances of congenital palsy of cerebral origin is, however, obscure, the more so as it sometimes happens that cases in which palsies of the eye muscles are present at birth as a consequence of a faulty development of the orbit, manifest cerebral complications later on in life.

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[2] Die Neurologie des Auges, p. 89.

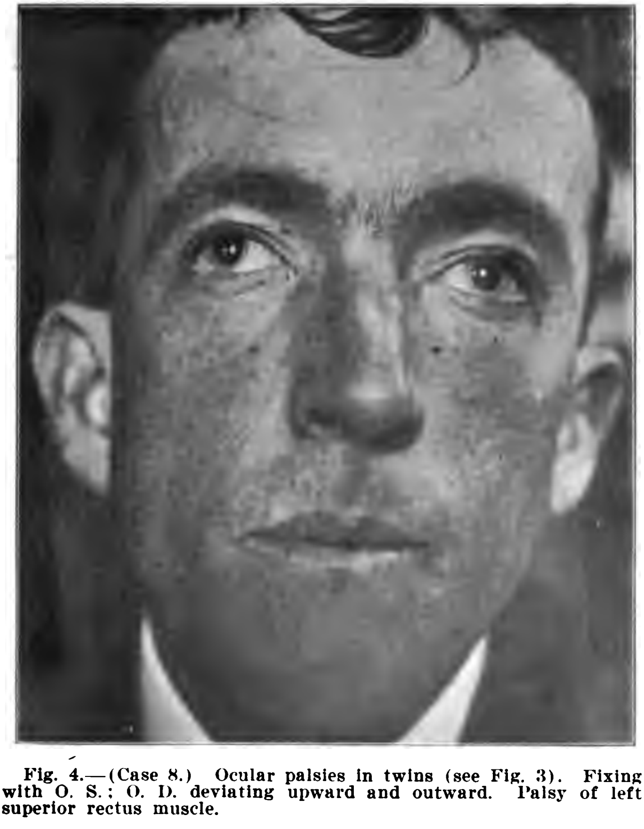

Fig. 4.—(Case 8.) Ocular palsies in twins (see Fig. 3). Fixing with O. S.; O. D. deviating upward and outward. Palsy of left superior rectus muscle.

It is not necessary, however, to go further into the causes which operate in the production of these prenatal palsies. Those interested may find an excellent exposition of the subject by Mills.[3] It will suffice to say that traumatism, infectious diseases, fright and other maternal impressions, may act through the mother. Not a few of the cases are due to developmental arrests, under which circumstances, according to Mills, the brain fails to develop because it lacks embryonal potentiality.

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[3] Diseases of the Nervous System, p. 614.

According to Bernheimer[4] disturbances in the development of the eye and its appendages may occur at any stage of gestation, and may not rarely be attributable to primary diseased conditions of the parents at the time of conception.

The tendency of a defect in the ocular motility to be transmitted by heredity is well recognized, and this may be remarked in successive generations or under atavistic conditions. In some families the defect may appear through several generations only in the males, while in others it may appear in the descendants of both sexes. Under such circumstances the squint does not always conform to a fixed type, deviations in its character being noted in successive generations.

In addition to the actual defect in motility in the region of action of the ocular muscles as a consequence of heredity, it should be remembered, as Duane has pointed out, that heredity plays an important part in inducing the conditions, arteriosclerosis, syphilis, etc., which frequently lead to paralysis.

Congenital palsy is especially common among the Jews; of 19 cases of disturbed motility collected by Kunn, 11 being of this race.

Among the peripheral causes which may occasion congenital palsy may be mentioned the following:[5]

1. Absence of the muscle, e. g., absence of the internus (Krause, Lawford), the externus (Krause, Bahr), the superior rectus (Seiler, Steinheim), both inferior recti (Stieren, A. E. Davis), and one or both obliques (Hartes, Seiler).
2. Replacement of muscles by a more or less inelastic cord of connective tissue. This has been observed in the case of the internus (Uhthoff, Guende), and the externus (Baumgarten, Inouye, Alling, Axenfeld and Schürenberg, Evans, Bernheimer).
3. Underdevelopment of the muscle. This has been observed by Lawford, Bach and others. A moderate degree of underdevelopment is considered by Schneller to be a frequent cause of squint (structural squint). This view he bases on the findings in numerous squint operations. It is questionable, however, whether the underdevelopment that he found was not rather the result than the cause of the squint.

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[4] Graefe-Saemisch, 2d Ed., xxxix, p. 33.

[5] Duane: Loc. cit., p. 222.

4. Abnormal course and insertion of the muscle. Among the abnormal conditions found are: (a) Insertion of the muscle too far back, causing it to act as a retractor rather than a rotator of the eye (Heuck); (b) bifurcation of the tendon (Dieffenbach, Bahr[6]), and (c), the presence of adhesions or bands connecting the muscles with each other or with the orbital walls (Morgagni, Olbers and Wrisberg, Fitzgerald).

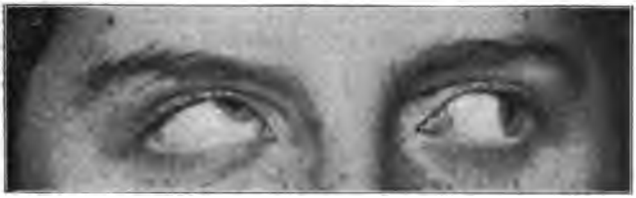

Fig. 5.—(Case 9.) Overaction of right inferior oblique, secondary to paresis of left superior rectus muscle. Looking to the extreme left, O. S. fixing and O. D. tilting up and in as a consequence of overaction of right inferior oblique.

While in all probability the sublying condition in many of these cases is associated with some disturbance in the embryonal formation of the eye muscles,[7] in nearly all there is evidence of faulty development of the orbit itself. Actual measurement will reveal unequal dimensions in the two orbits, and a comparison will often show that one is on a higher plane than its fellow. Further investigation discloses that the asymmetry of the orbit is dependent on other abnormality, for the skull in such cases will frequently be found to be misshapen; a misshapen skull, an abnormally developed

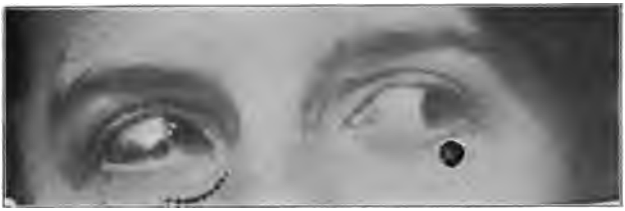

Fig. 6.—(Case 9.) Still looking to the extreme left, the tilting of O. D. up and in having been practically overcome by tenotomy of the right inferior oblique muscle. Dotted line shows incision made for tenotomy. Discoloration of sclera to temporal side is due to subconjunctival ecchymoses.

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[6] In Bahr's case one of the slips was inserted too far back, causing the muscle to act partly as retractor.

[7] Rider: A System of Ophthalmology, i, 67.

orbit and faultily inserted and anomalous muscles being the sequential factors in the causation of many of these cases. Lesser degrees of malformation occasion but a *tendency* toward deviation in the optic axes and are the sublying factor in so-called heterophoria, the difference in the deviation being one of degree only, and, while the greater deviation occasions more marked and disturbing conditions in the musculature of the eyes and in the muscles of the head and chest, the chain of causes evoking them is the same.

In his recent book, Stevens dwells at length on the importance which the development of the orbit has on the equilibrium of the muscles of the eye, and it is unnecessary to refer to the many observations which have been made by others on the influence which the form of the orbit has on the refraction. In most of the cases of congenital squint I have observed there was some departure from the normal, either in the shape of the skull or at least of the orbits, and there were but very few palsies which occurred in perfectly developed and otherwise normal individuals, stigmata of degeneration of some kind being nearly always visible. The most striking demonstration of this association was seen in three sets of twins, members of different families. The skulls of all six were under sized and otherwise misshapen, and the bones of the face were underdeveloped. Convulsions had occurred in three, and in five out of the six there were very marked ocular deviations.[8]

Congenital squint is not a very common condition; thus, of 17,000 patients I have seen in my service at the Wills Eye, the Howard and the Polyclinic hospitals, but 53 cases of this variety of strabismus were recorded, in comparison with 309 cases of concomitant squint.

As already indicated by Duane,[1] this form of palsy may affect any of the eye muscles, and types of deviation may be very varied. This is well demonstrated by the character of the deviations which occurred in my cases. It will be noted, however, that while each case was made to conform to some particular type of muscle palsy, the position which the eye assumed did not in all instances conform to the standards which authorities have assumed for the deviations occasioned by such palsies. This is accounted for in some of the cases by the changes induced in the muscles by secondary contractions and by the mixed character of the palsy as a consequence of the involvement of more than one muscle, and in others because of anomalous insertions of the muscles into the globe. Deviations due to this latter cause undoubtedly form a very considerable proportion of cases of congenital squint, and, while it is manifestly improper to designate them as palsies. they may, for convenience in classification, be described as conforming to this or that type of muscular paralysis.

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[8] Cases Nos. 1, 7 and 8; 36 and 37.

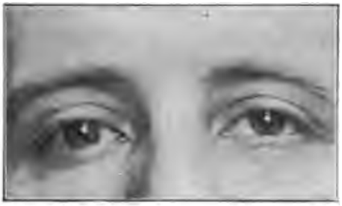

Fig. 7.—(Case 10.) Palsy of right superior rectus muscle. Fixing with right eye, O. S. deviating outward and slightly upward.

The notes of the 49 cases which occurred in my hospital services which are appended, together with those of 21 taken at random from my private cases, will be found to be much abbreviated, the diagnosis of the muscle or muscles at fault with the chief deviations. alone being given in most instances. This has been done partly on account of the necessity of keeping the paper within bounds, but largely because no more detailed study had been made of most of the cases. In a large clinical service, it is often impossible to study the ocular movements as thoroughly as could be desired, and the accurate measurements of the deviations so admirably de-

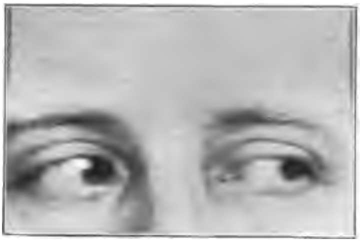

Fig. 8.—(Case 10). Looking to extreme left. Both eyes fixing.

scribed by Duane[9] are impracticable. The photographs of a number of cases have been given and in several instances the effects of operations which had been performed on the eyes have been demonstrated in this way.

The types of muscular insufficiency demonstrated by the cases were as follows:

ANOTROPIA.

CASE 1.—Child, aged 6 years, with skull too long in the antero-posterior diameter and orbits deeper and narrower than normal. A twin sister, examined at the same time, presented much the same shaped skull and orbits, but no ocular symptoms. When fixing in the median line, and screen placed over the right eye, O.D. deviated directly up under cover, slowly but steadily swinging down again to fix. When the left eye was screened off the deviation was up, but also in, in the same slow rhythmical fashion as in O.D. There seemed to be a lagging in the left eye when the object was carried down to the right, and this eye showed a tendency at times to slight convergent strabismus. H. equaled 1.5 D. in each eye. Vision was normal. This child had had convulsions, which were thought by Dr. W. G. Spiller, who saw the case in consultation, to be due to premature birth and to belong to the class of cases described by him under Little's disease.[10]

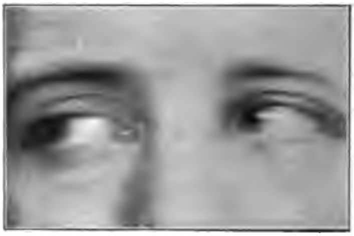

Fig. 9.—(Case 10.) Looking to extreme right. Photograph blurred, due to the invariable movement of patient's head and eyes when looking to the right. O. D. fixing; O. S. deviating up and in, due to overaction of the left inferior oblique muscle. Tenotomy performed on left inferior oblique, correcting in large measure the upward and inward tilting of O. S.

This rare anomaly of the ocular muscles has been described by Stevens[11] under the name of anotropia. He says that in these cases there is excess of the upward rotation in each eye, associated with a declination of the meridians, as a consequence of which the simultaneous and synergic action of the superior obliques is suppressed and the superior recti act alone.

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[9] The Eye and the Nervous System, and Ann. of Ophth., October, 1904.

[10] Univ. of Pa. Med. Bull., January, 1905.

[11] Motor Apparatus of the Eye, 223.

PALSY OF BOTH SUPERIOR RECTI MUSCLES.

Case 2.—Boy, aged 8, brother of patient in Case 3. Birth difficult, two weeks over time; head presentation, in a difficult position; labor long and patient much exhausted. Five other children, one cross-eyed; child now strong; head well shaped. O.D., convergent squint of 45 degrees; object carried to extreme right, O.S. goes up and in; object carried to left, O.D. goes up and in (overaction of both inferior obliques); object carried up, convergence increases.

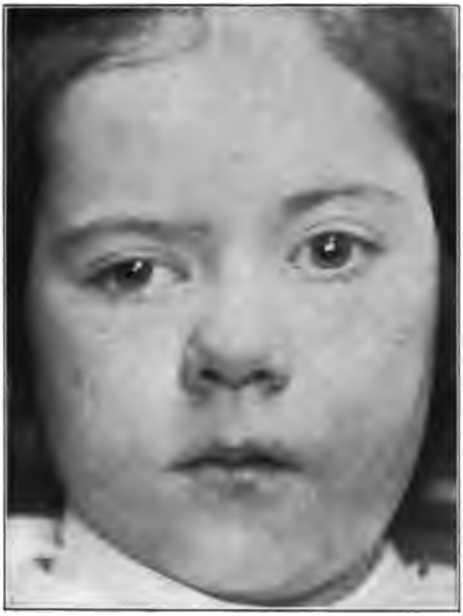

Fig. 10.—(Case 17.) Paralysis of right superior and internal recti muscles. Primary position: O. S. fixing; O. D. deviating outward and slightly downward. Showing cranial asymmetry.

O.D. + S. 1.5 D. ≎ + C. 0.50 D. ax. 90° = 5/22.
O.S. + S. 1.5 D. ≎ + C. 1.25 D. ax. 90° = 5/5.

PALSY OF RECTUS SUPERIOR OF RIGHT EYE.

Case 3.—Girl, aged 13, sister of patient in Case 2. O.S., convergent squint 25 degrees; object carried to the right, O.S. goes up and in; movements to left normal; limitation of upward and outer motion in O.D.

CASE 4.—Female, aged 4. H. equals 2 D. in each eye. O.D., convergent squint with slight upward deviation; defective upward, and especially up and outward motion in each eye, with overaction of both inferior obliques as eyes are rotated to external limits of their outward rotation.

CASE 5.—Female, aged 3. O.D., H. equals 1 D.; O.S., H. equals 1 D.; O.D., convergent 45 degrees. Same character of deviations as in Case 4.

PARESIS OF BOTH SUPERIOR RECTI AND OF RIGHT RECTUS EXTERNUS MUSCLES.

CASE 6.—Male, aged 10 (Figures 1 and 2). Good mentality; head well formed, but face underdeveloped; pronounced wry neck; head held in oblique position, right side of face presenting. Primary position O.D., convergent strabismus, 45 degrees; object carried to the right, O.D. fixing, O.S. deviates up and in; object carried to the left, O.S. fixes and O.D. deviates up and in; both eyes deviate upward under cover; marked limitation in outward rotation of O.D.

Tenotomy of Both Inferior Oblique Muscles.—Removed the upward and inward deviation of the eyes.

Advancement of Right Rectus Externus.—Resulted in parallelism of visual axes; two months after operation no appreciable change in wry neck. Dr. James K. Young, who saw the patient on admission, reported contraction of left sternocleido mastoid with chin toward the right; left cervical, right dorsal, and slight left lumbar curve; slight hemiatrophy of left side of face.

PALSY OF BOTH SUPERIOR RECTI.

CASE 7.—E. S., aged 23, twin of patient in Case 8. (Fig. 3).

O.D. V. = 6/6; H. + A.H. = 2 D.
O.S. V. = 6/6; H. + A.H. = 2 D.

Divergent squint in O.S.; fixing with O.D., O.S. diverges about 20 degrees; object carried to left, O.D. goes up and in; object carried to right, O.S. goes up and in; object carried up, both eyes lag and diverge, this being more pronounced in O.S.

PALSY OF LEFT SUPERIOR RECTUS.

CASE 8.—O. S., twin of preceding. (Fig. 4).

O.D. V. = 6/6; H. + A.H. = 1.5 D.
O.S. V. = 6/9; H. + A.H. = 1.5 D.

O.D., divergent squint; fixing with O.S., O.D. diverges 30 degrees, and at times slightly up; fixing with O.D., O.S. diverges 30 degrees, and at times slightly down; object carried to left, O.D. turns up; object carried to right, O.S. turns up; object carried up, O.D. fixing, O.S. lags behind; object carried up, O.S. fixing, O.D. lags behind. Six brothers and four sisters have normal eyes. High vault of palate; facial bones underdeveloped; both heads were exceptionally small at birth, and are still much undersized; no other palsies in body; convulsions since 1 year old.

PARESIS OF LEFT SUPERIOR RECTUS WITH OVERACTION OF RIGHT INFERIOR OBLIQUE.

Case 9.—Female, aged 17. (Figures 5 and 6).

O.D. V. = 5/6; H. + A.H. = 2 D.
O.S. V. = 5/5; H. + A.H. = 4 D.

Fixing in median line, eyes are straight; object carried to right O.D. lags and O.S. turns slightly up and in; object carried to left, O.S. rotates normally outward and O.D. deviates up and in; object carried up, O.S. fixes and O.D. diverges up and out, these motions being attended with marked wheelmotion in O.D.; O.D. goes slightly up under cover and diverges when patient looks up.

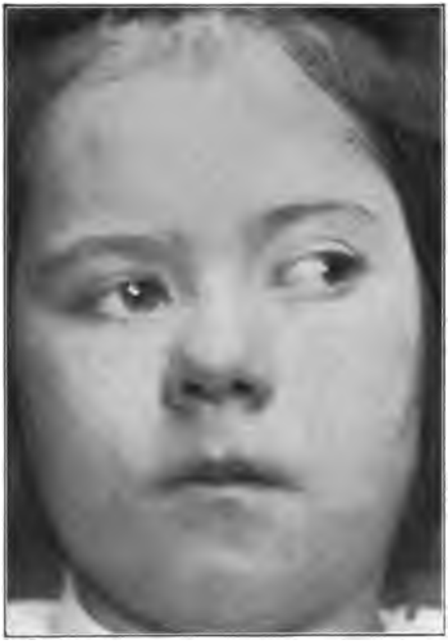

Fig. 11.—(Case 17.) Looking to extreme left, both eyes fixing normally.

Tenotomy O.D. Inferior Oblique.—Now no deformity in primary position, but when eyes are directed to the limit of their rotary power to the left, O.D. still deviates somewhat up and in.

PALSY OF RIGHT SUPERIOR RECTUS.

Case 10.—(Dr. Cramer's)—Male, aged 30. (Figures 7, 8 and 9).

O.D. + S. 0.50 D. = 6/4; Exophoria 12°.
O.S. + C. 0.50 D. ax. 180° = 6/5; left Hyperphoria 20°.

Fixing in median line, O.D. fixes and O.S. deviates out and slightly up; looking to the left, both eyes fix normally; looking to the right, nystagmus appears; O.D. lags up and out, and O.S. tilts up and in; upward and outward movement in O.D. restricted.

Tenotomy of O.S. Inferior Oblique.—Reduced hyperphoria to 3 degrees, lessening the upward and inward rotation of O.S. and giving marked relief to certain head symptoms and making the movements of the eyes freer.

Case 11.—Female, aged 16.

O.D. V. = 5/12; H. = 2 D.
O.S. V. = 5/12; H. = 2 D.

O.S., convergent squint; O.S. deviates in and up behind the screen, while when O.S. fixes, O.D. deviates in and slightly down; the face is turned somewhat to the right and up.

Case 12.—Female, aged 7.

O.D. + S. 3 D. ⊃ + C. 0.75 D. ax. 90° = 5/12.
O.S. + S. 1.75 D. ⊃ + C. 0.25 D. ax. 90° = 5/5.

O.D., convergent squint, 30 degrees; eye turns slightly down as well as in; fixing with O.D., O.S. goes up and in under cover; object to right, O.S. goes up and in (left inferior oblique); object to left, O.D. makes no abnormal movement; limitation of motion in O.D., up and out. Labor difficult and instruments used.

Note.—A brother, aged 3, shows a tendency to convergent squint in right eye, but with no tilting movements.

Case 13.—Female, aged 17.

O.D. V. = 6/60; H. = 2 D.
O.S. V. = 6/6; H. = 2 D.

O.D., convergent 30 degrees; restriction in upward motion especially when eye is directed to the right, and left eye deviates up and in; face is turned to the right and slightly up; when fixing object carried to right, O.S. fixes and O.D. deviates down and out.

O.D. inferior rectus divided, bringing eye up to level with its fellow, so that in ordinary fixation eyes are straight, but on close fixation O.S. converges 20 degrees. Advised advancement of O.D. rectus superior.

Case 14.—Female, aged 6.

O.D. + S. 2.5 D. = 5/10.
O.S. + S. 2.5 D. ⊃ + C. 0.75 D. ax. 90° = 5/20.

Child is youngest of 10; eyes of other children normal: father is cross-eyed; in primary position, O.S. turns up and in; fixes well with O.S., but binocular vision at once resumed with O.D.; some limitation of O.D. upper and outward movement; object carried to the right, O.D. lags in upward movements and O.S. tilts up and in; when fixing with O.D., O.S. rotates up and in behind screen.

PALSY OF LEFT SUPERIOR AND LEFT EXTERNAL RECTUS MUSCLES.

Case 15.—Male, aged 23.

O.D. V. = 5/5 ; H. + A.H. = 3 D.
O.S. V. = 5/10 ; H. = 2 D.

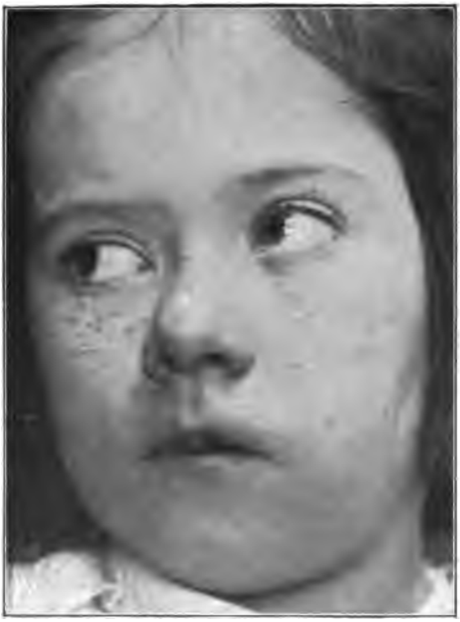

Fig. 12.—(Case 17.) Looking to extreme right, O. D. fixing, O. S. deviating up and in.

O.S., divergent 20 degrees; fixes well with O.S. when O.D. diverges similarly; nystagmus in each eye when object carried to right or left; object carried to extreme right, O.S. turns down and in; object carried to extreme left, O.D. moves in conjunction with O.S.; adduction good in both eyes; O.S. rectus superior in all probability is absent (O.S. does not go up and in in ordinary motion to right); marked limitation in O.S. upward motion; O.D. deviates upward and to the right under cover; when fixing object below, convergence is good, but above both eyes diverge.

Advancement of O.S. Rectus Internus Muscle.—Relieved the divergence, but without effect on nystagmus.

PALSY OF RIGHT SUPERIOR RECTUS AND LEFT LEVATOR PALPEBRÆ.

CASE 16.—Female, aged 17.

O.D. V. = 4/36 ; M. = 3 D.
O.S. V. = 3/60 ; M. = 3 D.

O.S., ptosis; O.D. deviated downward and slightly out; object carried up, O.D. lags behind, especially up and out; fixing with O.D., O.S. deviates up and out under cover; fixing with O.S., O.D. down and out under cover.

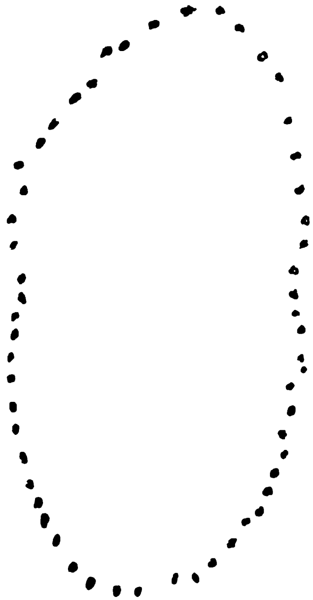

Fig. 13.—(Case 17.) Conformity of skull obtained with hatter's mold, showing marked asymmetry.

PARALYSIS OF RIGHT SUPERIOR AND INTERNAL RECTUS MUSCLES.

CASE 17.—Female, aged 8 (Figures 10, 11, 12 and 13).

O.D. V. = 5/12 ; H. = 3 D.
O.S. V. = 5/5 ; H. = 1 D.

Pronounced cranial asymmetry; skull irregularly flattened laterally; marked prominence of right temple and of occipital protuberance; the left supraorbital ridge receding, that on the right side well developed; nose curved to the right; fixes with

O.S., O.D. diverging 30 degrees and deviating somewhat downward; object carried to the left, both eyes fix normally; object carried to the right, O.D. fixes, O.S. deviating markedly up and in; marked deficiency in upward and outward motion in O.D.; O.S. deviates up and out behind screen.

Prolonged and difficult labor; face presentation; head much misshapen after birth; physician at confinement said cord was abnormally short. Since child was five months old the mother has continually practiced straightening the head by forcibly pressing on it on the anteroposterior axis. Dr. W. G. Spiller believes the child to be the subject of infantile cerebral hemiplegia. Dr. J. K. Young has recently operated on child for tendon contractions in both legs.

Right Rectus Superior Advanced.—Supplemented the movements of the globe in the direction supplied by this muscle. Secondary deviation of the left eye, up and out, overcome by *tenotomy of left rectus superior.* Parallelism of visual axes obtained by *advancement of right internal* rectus.

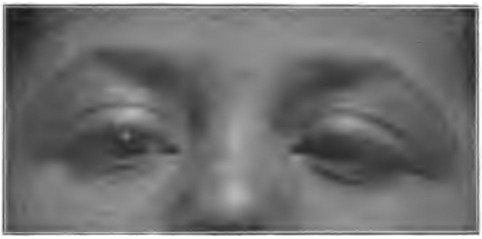

Fig. 14.—(Case 19.) Palsy of right superior rectus with overaction of left inferior oblique and left internal rectus muscles. O. D. fixing; O. S. deviating inward. (Head steadied from behind.)

PALSY OF RIGHT SUPERIOR RECTUS AND INTERNAL RECTUS MUSCLES.

CASE 18.—Female, aged 18.

O.D. + S. 4 D. ○ + C. 2 D. ax. 90° = 5/10.
O.S. + S. 4 D. = 5/10.

Father and mother and brother and sisters deaf mutes. O.S., divergent 35 degrees; inability to rotate eye up, especially up and out, with restriction of motion in, and especially down and in; object carried to the right, O.S. goes up and in (overaction of left inferior oblique); ocular movements in O.D. good; no secondary deviations.

PALSY OF RIGHT SUPERIOR RECTUS WITH OVERACTION OF LEFT INFERIOR OBLIQUE AND LEFT INTERNAL RECTUS MUSCLES.

CASE 19.—Hebrew male, aged 12 (Figures 14 and 15). Misshapen skull, small orbits, left side of face underdeveloped. Fixing in median line, O.D. fixes, O.S. deviating inward; limitation of upward and outward motion in O.D.; object carried to the right, O.D. tilts markedly up and in; object carried to the left, O.S. lags and O.D. deviates slightly downward; head thrown back and face turned to the right and up, putting muscles of neck on stretch; rotary nystagmic movements on fixation in each eye.

PALSY OF LEFT RECTUS SUPERIOR.

CASE 20.—Male, aged 5.

O^2 H. + A.H. = 3 D.

O.S. deviated downward and slightly outward; marked limitation of motion in O.S. up and out; O.D. tilts up and in when muscles of neck on stretch; rotary nystagmatic movements on fixation in each eye.

CASE 21.—Female, aged 8.

O.D. V. = 5/30 ; H. = 4 D.
O.S. V. = 5/30 ; H. = 5 D.

O.S., convergent 20 degrees; rotation limited to temporal side and up; object carried to the left, O.D. goes up and in. Face turned toward left.

CASE 22.—Female, aged 6, youngest of seven; patient alone cross-eyed.

O.D. + S. 1.75 D. ⊃ + C. 1.50 D. ax. 90° = 5/15.
O.S. + S. 2.00 D. ⊃ + C. 0.75 D. ax. 90° = 5/35.

When fixing in median line, O.D. goes up and slightly in; fixes well with O.D., but binocular vision resumed with O.S.; when finger is carried to the left, O.D. goes markedly up and in; when finger is carried to the right, O.D. fixes and O.S. is carried up and in; O.S. goes down and in under cover, O.D. up and in; limitation of upward motion in O.S., especially up and out.

CASE 23.—Female, aged 9.

O.D. V. = 6/30 ; H. = 5.00 D.
O.S. V. = 6/15 ; H. = 1.50 D.

O.S., divergent 35 degrees; object carried to left, O.D. fixes and O.S. deviates down and out; object carried to right, O.D. fixes and O.S. deviates up and in; object carried to right and O.S. made to fix, O.D. deviates up and in; object carried up, ocular movements good; object carried down, ocular movements good; constant rotary nystagmus in both eyes; spasms since early childhood. Head small.

CASE 24.—Female, aged 10.

O.D. V. = 5/35 ; H. + A.H. = 2 D.
O.S. V. = 5/09 ; H. + A.H. = 2 D.

O.D., convergent squint, eye being deviated up and in, as a consequence of spasm in inferor oblique, secondary to palsy of left superior rectus; limitation of motion in O.S. up and out: O.D. fixing, O.S. deviated down.

Case 25.—Male, aged 21.

O.D. V. = 6/6 ; H. = 2 D.
O.S. V. = 6/9 ; H. = 3 D.

O.D., convergent and deviated slightly up; O.S. upward motion restricted; fixing object carried to left and slightly up, O.S. lags and O.D. lags up and in (overaction of right inferior oblique).

Case 26.—Female, aged 8.

O.D. V. = 5/15 ; H. = 5 D., with marked astigmatism.
O.S. V. = 5/30 ; H. = 5 D., with marked astigmatism.

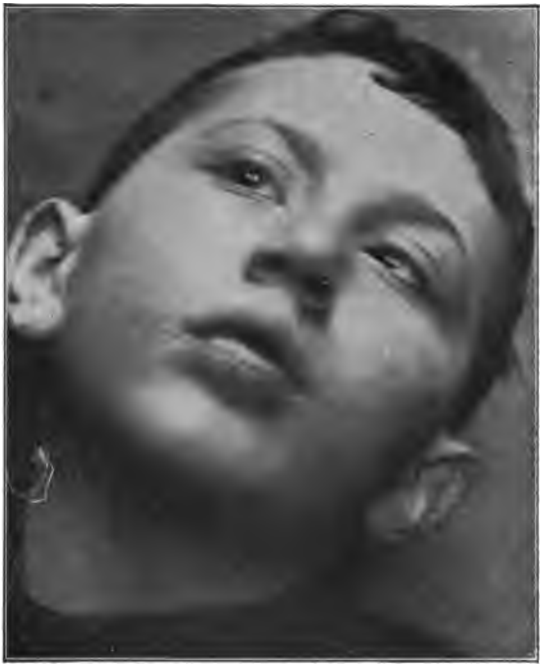

Fig. 15.—(Case 19.) Showing head thrown back and face turned toward right and up, putting muscles of neck on stretch. A position often assumed in attentive fixation.

O.S., convergent 40 degrees, but ocular movements good; when object is carried to the left, O.D. turns in and up; when object is carried to the right, both eyes fix normally; some limitation in upward motion in O.S.

PALSY OF BOTH SUPERIOR OBLIQUE.

Case 27.—Male, aged 16 months. Palsy of both superior obliques; O.D. the preferred fixing eye; alternating convergent squint; both eyes deviate up and in; no secondary deviations; limitation of downward motion in each eye.

PALSY OF RIGHT SUPERIOR OBLIQUE WITH SPASM OF RIGHT INFERIOR OBLIQUE.

Case 28.—Male, aged 10.

O.D. V. = 6/35 ; H. + A.H. = 2 D.
O.S. V. = 6/22 ; H. + A.H. = 3 D.

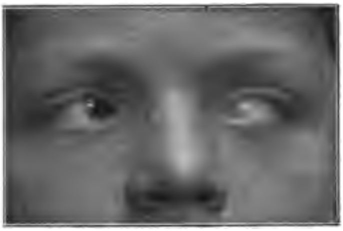

Fig. 16.—(Case 32.) Insufficiency of both inferior oblique with overaction of both superior recti muscles. Looking to the extreme left, O. D. fixing; O. S. tilting upward and outward under the upper lid, due to overaction of left superior rectus muscle.

O.D. deviates up and in, the deviation being more pronounced as fixing object is carried to the left; downward motion in O.D. limited especially down and in; no primary or secondary limitation or exaggeration of motion in left eye.

Free tenotomy of right inferior oblique relieved the tilting up and in, but eye still shows tendency to converge at times.

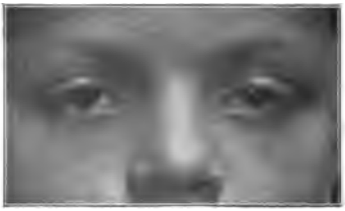

Fig. 17.—(Case 32.) Primary position: O. D. convergent 5 degrees.

PALSY OF LEFT SUPERIOR OBLIQUE.

Case 29.—Male, aged 21.

O.D. V. = 3/22 ; M. + A.M. = 5 D.
O.S. V. = 1/22 ; M. + A.M. = 6 D.

O.S., convergent 30 degrees, and slightly up; face turned somewhat towards right; fixing downward, O.S. lags especially to the right; O.D. deviates down and slightly to the left under cover; object carried to the left, O.S. goes slightly higher; object carried to the right, O.S. goes up and in.

Case 30.—Female, aged 45.

O.D. V. = 5/22 ; H. = 3 D.
O.S. V. = 5/09 ; H. = 2 D.

O.D., convergent 15 degrees, and slightly downward; no restriction of ocular movements; O.S. deviates slightly upward and inward under cover; object carried to the right, O.D. goes down and out.

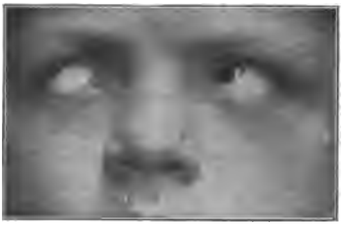

Fig. 18.—(Case 32.) Looking to extreme right, O. S. fixing; O. D. tilting upward and outward under the lid, due to overaction of right superior rectus muscle.

PALSY OF RIGHT INFERIOR OBLIQUE AND OF LEFT INFERIOR RECTUS.

Case 31.—Male, aged 27.

O.D. V. = 4/60 ; H. + A.H. = 3 D.
O.S. V. = 5/22 ; H. + A.H. = 3 D.

O.D., convergent 25 degrees; limitation of downward motion, especially to the left; when fixing with O.D., O.S. deviates up and in; when fixing with O.S., O.D. deviates down and in; limitation of upward motion in O.S.

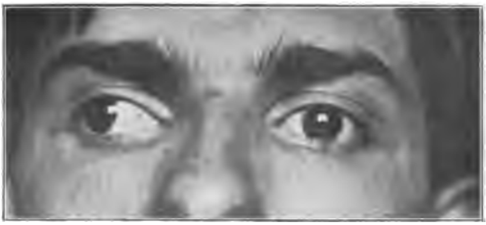

Fig. 19.—(Case 33.) Alternating divergent squint. Palsy of both inferior recti muscles. Fixing with O. S.: O. D. divergent and deviating slightly upward.

INSUFFICIENCY OF BOTH INFERIOR OBLIQUE MUSCLES WITH OVERACTION OF BOTH SUPERIOR RECTI MUSCLES.

Case 32.—Male, aged 4 (Figures 16, 17 and 18). Parents had noticed that since infancy, when looking at distant objects, one eye would be apt to roll so far out and up in the corner of the eye that the pupil would almost disappear. Child is well formed and strong; no convulsions or illness; head large and of good shape. In primary position O.D. is convergent 5 degrees; when the examining object is carried to the right, O.S. fixes, O.D. deviating far up and out; when the object is carried to the left O.S. goes up and out, O.D. fixing; object carried straight up, O.S. fixes and O.D. diverges; object carried down, O.D. diverges also. Cover test: O.D. fixing, O.S. goes up and out under cover; O.S. fixing, O.D. goes up and out under cover.

PALSY OF BOTH INFERIOR RECTI.

CASE 33.—Male, aged 23 (Figures 19, 20, 21, 22 and 23).

O.D. V. = 6/60; M. = 3 D.
O.S. V. = 6/60; M. = 3 D.

Alternating divergent squint, 35 degrees; no nystagmus; fixes well with each eye; object carried to extreme left, O.S. fixes and O.D. turns down and in; object carried to extreme right, O.D. fixes and O.S. turns down and in; upward motion in both eyes good; downward, limited and divergence of visual axes more pronounced. The eyes being carried down and in when object carried to right and left, indicate an overaction of the superior obliques showing probable palsy of left inferior recti muscles.

Tenotomy of both superior recti muscles performed.—O.D. muscle found to have an unusually broad insertion; that of O.S. normal. One month after operation eyes diverge somewhat, though adduction is excellent.

Tenotomy performed on O.D. rectus externus.—The insertion of this muscle into the globe also found to be unusually broad. Two weeks after this operation eyes in excellent position, the divergence of the visual axes having been overcome, but O.D. is on a slightly lower level than its fellow.

Readjustment of O.D. rectus superior by advancement, bringing eye on a level with its fellow. Two weeks later, eyes straight, binocular vision and patient unaware of any limitation of motion; no diplopia.

PALSY OF LEFT INFERIOR RECTUS.

CASE 34.—Female, aged 8.

O.D. V. = 6/6.
O.S. V. = Fingers at 1 meter.

O.S. deviated up and in; limitation of motion downward and especially to the left; O.D. deviates downward and slightly inward behind screen.

PALSY OF RIGHT INFERIOR RECTUS.

CASE 35.—Female, aged 16.

O.D. V. = 6/30; H. = 1.5 D.
O.S. V. = 6/20; H. = 1 D.

O.D. deviated upward and outward, the latter increasingly in the upper half of the field; limitation in downward motion; no apparent secondary deviation in the fellow eye.

Case 36.—Male, aged 11, twin of patient in Case 37.

O.D. + S. 3.50 D. ⊃ + C. 0.37 D. ax. 180° = 5/6.
O.S. + S. 3.75 D. ⊃ + C. 0.50 D. ax. 160° = 5/9.

O.S., convergent 30 degrees and slightly down; object carried to right, O.S. down and in; object carried to left, O.D. up and in; O.D. limitation of motion downward most marked when the eyes are turned to the right; O.S. held in position of secondary deviation, i. e., inward and downward; some flattening of left side of forehead; anomalous insertion of teeth in upper jaw.

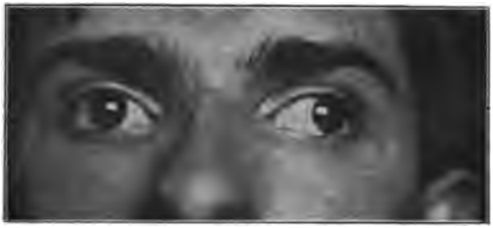

Fig. 20.—(Case 33.) Fixing with O. D.; O. S. divergent and deviating slightly upward.

PALSY OF RIGHT RECTUS EXTERNUS.

Case 37.—Male, twin of patient in Case 36.

O.D. + S. 4.25 D. ⊃ + C. 0.37 D. ax.   5° = 5/9.
O.S. + S. 4.25 D. ⊃ + C. 0.50 D. ax. 170° = 5/6.

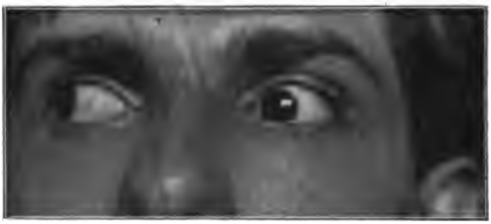

Fig. 21.—(Case 33.) Looking to extreme right, O. D. fixing; O. S. deviating somewhat downward.

O.S., convergent squint 45 degrees and slightly up; difficulty in external motion in O.D.; fixes well with O.S., but binocular vision at once resumed with O.D.

PALSY OF LEFT INFERIOR RECTUS MUSCLE.

Case 38.—Male, aged 15.

O.D. V. = 5/15.
O.S. V. = 5/10.

O.S., convergent squint; O.S. deviates in downward and outward movements and is carried in as object is moved about the horizontal plane; O.D. deviates downward and slightly to the right behind the screen; all movements accompanied with short rotary nystagmus.

PARESIS OF BOTH EXTERNAL RECTI MUSCLES.

CASE 39.—Female, aged 25.

O.D. V. = 5/5 ; H. = 2 D.
O.S. V. = 1½/45 ; H. = 2 D.

O.S., convergent 45 degrees; vertical nystagmus more pronounced in O.S. than in O.D., with limitation of external movements in each eye.

CASE 40.—Infant, aged 10 months. Convergent squint of 20 degrees in the right eye. In testing it was elicited that the squint appeared in each eye alternately, and that there was absolute inability to rotate either eye beyond the median line when the eyes were directed outwards. All other muscles acted normally and the child was well developed and healthy. Pupils were 3 mm. in size and reacted well to light stimuli. The fundi were normal.

CASE 41.—Female, aged 6.

O.D. + 5 ; vision not noted.
O.S. + 5 ; vision not noted.

O.D., convergent 60 degrees; can not fix with that eye; nystagmus in both eyes increased on fixation; some limitation in outward rotation in each eye, with overaction of interni as object carried to right or left.

PALSY OF BOTH EXTERNAL RECTI AND OF SUPERIOR AND INFERIOR RECTI MUSCLES OF RIGHT EYE.

CASE 42.—Male, aged 28.

C. O.D. V. = 1/60 ; M. = 16 D.
C. O.S. V. = 6/15 ; M. = 10 D.

O.D. converges 35 degrees and deviates slightly upward; marked limitation of outward motion; fixing object carried to the left, limitation in outward motion in O.S.; fixing object carried to the right O.S. fixes, O.D. deviating up: (insufficiency of external recti of both eyes and right inferior rectus); fixing object carried up, O.S. fixes and O.D. still converges; fixing object carried down, O.S. fixes and O.D. still converges: inability to rotate O.D. up and out (insufficiency of superior rectus muscle).

PALSY OF BOTH EXTERNAL RECTI MUSCLES.

CASE 43.—Male, aged 32.

O.D. V. = 5/22 ; H. + A.H. = 3 D.
O.S. V. = 4/44 ; H. + A.H. = 3 D.

Epileptic since birth. Alternating convergent squint, O.D. fixing by preference; occasional rotary nystagmus in both eyes on fixation, especially up; weakness of both external recti muscles, and in looking to the right limitation in O.D. in upward and outward movements. Probable paresis of right inferior oblique.

PALSY OF RIGHT EXTERNAL RECTUS.

Case 44.—Female, aged 10.

O.D. V. = 3/60 ; H. = 5 D.
O.S. V. = 3/60 ; H. = 5 D.

O.S., convergent strabismus; marked limitation in external rotation in O.D., the convergent squint in O.S. being due to secondary deviation.

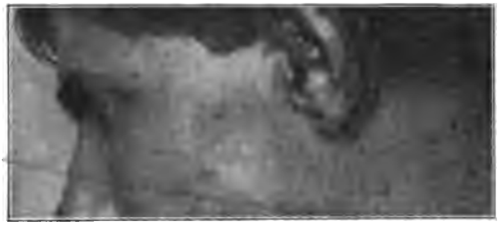

Fig. 22.—(Case 33.) Profile showing shallow orbit.

PALSY OF RIGHT RECTUS EXTERNUS.

Case 45.—Male, aged 14.

O.D. V. = 6/9 ; H. = 2 D.
O.S. V. = 6/12 ; H. = 2 D.

O.S., convergent 20 degrees; object carried to right, O.D. lags with marked wheel motion in O.D.; O.D. downward motion good; O.D. motion out much restricted; O.D. motion up and out limited; O.D. motion down and out limited; object carried to left, O.S. lags somewhat; all attempts at fixation accomplished with marked rotary movements.

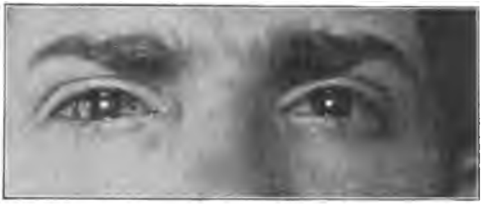

Fig. 23.—(Case 33.) Approximate parallelism of visual axes. Operation: tenotomy of both superior recti and right rectus externus, with final adjustment of right superior rectus by advancement.

Case 46.—Female, aged 4. O.D., convergent 45 degrees and slightly up; object carried to right, O.D. can not be rotated beyond median line; face turned to right, motion up and out and down and out also restricted; no deviation in left eye.

Case 47.—Male, aged 10.

O.D. V. = 6/60.
O.S. V. = 6/6.

O.D., convergent 40 degrees; limitation in outward motion beyond median line; movements in O.S. apparently unrestricted; right facial palsy.

PALSY OF RIGHT RECTUS EXTERNUS.

Case 48.—Male, aged 29 (Figures 24, 25 and 26).

O.D. V. = 1/60; H. + A.H. = 1.5 D.
O.S. V. = 6/6; H. + A.H. = 1.5 D.

O.D., convergent 45 degrees; limitation in outward motion as eye is rotated outward; some overaction of left external rectus in secondary deviation. *Advancement of right rectus externus muscle.*

Case 49.—Female, aged 11.

O.D. V. = 35/22; H. = 1 D.
O.S. V. = 5/6; H. = 1 D.

O.D., convergent 25 degrees; limitation of outward motion beyond median line; O.D. turns slightly up as object is carried to the right; secondary deviation downward of O.S., especially in the upper outer parts of the field.

Case 50.—Female, aged 8.

O.D. V. = 3/45; H. = 3 D.
O.S. V. = 5/30; H. = 2 D.

Holds head to right when fixing object; O.D., convergent squint 40 degrees; inability to rotate O.D. beyond median line; overaction of left rectus internus as object is carried to the right.

PALSY OF RIGHT RECTUS EXTERNUS.

Case 51.—Female, aged 20.

O.D. V. 5/45; H. = 3 D.
O.S. V. 5/5; H. = 3 D.

O.D., convergent 25 degrees; limitation in outward motion in O.D., with overaction of left internus as object is carried to the right; object carried up, O.S. lags up and in.

PALSY OF LEFT RECTUS EXTERNUS.

Case 52.—Female, aged 15.

O.D. V. = 6/6; H. = 1 D.
O.S. V. = 5/60; H. = 1 D.

O.S., convergent; limitation in outward motion; nystagmus in upward and downward movements; no secondary deviation in O.D.

Case 53.—Male, aged 19.

O.D. V. = 6/6; H. = 2.5 D.
O.S. V. = 6/22; H. = 2.5 D.

O.S., convergent; limitation in outward motion and especially below.

Case 54.—Female, aged 18.

O.D. V. = 5/60; H. + A.H. = 3 D.
O.S. V. = 5/60; H. + A.H. = 3 D.

O.S., convergent; unable to rotate O.S. externally beyond median line; upward movements also restricted; monocular nystagmus in O.S. when fixing with that eye.

Case 55.—Female, aged 26.

O.D. V. = 6/15; H. = 3 D.
O.S. V. = 1/60; H. = 3.5 D.

O.S., convergent 35 degrees; marked limitation of external rotary movement in O.S.; overaction of right internal in secondary deviation; some limitation of upper, outer motion in O.S.

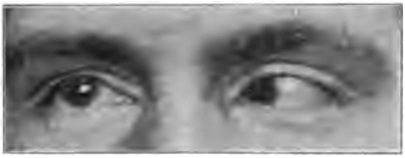

Fig. 24.—(Case 48.) Paresis of right external rectus muscle. Looking to the extreme right. Limitation of the outward rotation in O. D. as a consequence of palsy of the right rectus externus muscle.

Advancement of O.S. external rectus performed with subsequent satisfactory position of eyes.

Case 56.—Male, aged 11. Convergent squint; 30 degrees; no limitation of motion in O.D., but absence of external motion in O.S. beyond median line, the squint in O.D. being due to overaction of O.D. rectus internus as a consequence of secondary deviation.

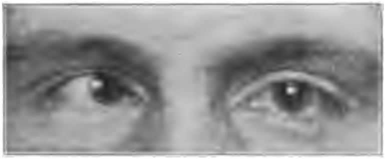

Fig. 25.—(Case 48.) Right convergent squint, O. S. fixing.

Note.—The father of this patient has a paralysis of left external rectus muscle of congenital origin also.

Case 57.—Male, aged 11.

O.D. V. = 5/45; H. = 2 D.
O.S. V. = 5/12; H. = 2 D.

O.D., convergent squint 20 degrees; marked limitation of motion in O.S. beyond median line; overaction of right rectus internus as object is carried toward left.

Case 58.—Female, aged 8.

O.D. V. = 5/10 ; + 3 marked astigmatism.
O.S. V. = 5/50 ; + 4 marked astigmatism.

O.S., convergent 20 degrees, with limitation of outward motion; vertical nystagmic movements in O.D. on fixation; no nystagmus in O.D., but slight tendency to overaction of right rectus internus when object carried to the extreme left.

Case 59.—Male, aged 19.

O.D. V. = 5/10 ; H. + A.H. = 2 D.
O.S. V. = 5/15 ; H. + A.H. = 2 D.

O.S., convergent 45 degrees; limitation of external motion; no secondary deviation in O.D.

Case 60.—Male, aged 12.

O.D. V. = 5/6 ; H. + A.H. = 2 D.
O.S. V. = 5/22 ; H. + A.H. = 2 D.

O.S., convergent 30 degrees, with limitation of external motion; no secondary deviation in O.D.

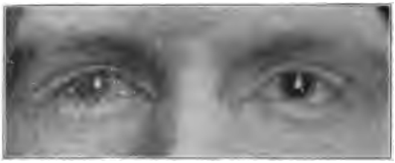

Fig. 26.—(Case 48.) Correction of squint by advancement of the right rectus externus muscle.

PALSY OF EXTERNAL RECTUS WITH PTOSIS OF LEFT EYE.

Case 61.—Male, aged 26.

O.D. V. = 6/6 ; H. = 2 D.
O.S. V. = 6/60 ; H. = 3 D.

O.S., convergent, with ptosis; marked limitation of external rotation in O.S.; no deviations, primary or secondary, in O.D.

PALSY OF LEFT EXTERNAL RECTUS AND RIGHT SUPERIOR RECTUS.

Case 62.—Male, aged 10.

O.D. V. = 5/22 ; H. + A.H. = 8 D.
O.S. V. = 5/30 ; H. + A.H. = 6 D.

Bones of face underdeveloped; orbit very shallow; marked lateral nystagmus in each eye on fixation; O.D., convergent squint 20 degrees; limitation in O.S. externally beyond median line; when object carried to the right, O.S. goes up and in; when object carried up, O.S. lags, especially up and out, but O.D. also lags and to a greater degree, especially up and out.

PALSY OF BOTH INTERNAL RECTI AND RIGHT SUPERIOR RECTUS MUSCLES.

Case 63.—Male, aged 9 (Figures 27 and 28).

O.D. V. = 3/40 ; + 2 D.
O.S. V. = 4/45 ; + 2 D.

Optic nerves partially atrophic; dome-shaped skull; frog face; alternating divergent squint; convergence abolished; marked restriction in inward motion of both eyes and of upward and outward motion in O.D.; lateral nystagmus on fixation; overaction of both external recti in lateral movements. Convulsions for past three years.

PARALYSIS OF LEFT INTERNAL RECTUS.

CASE 64.—Female, aged 13.

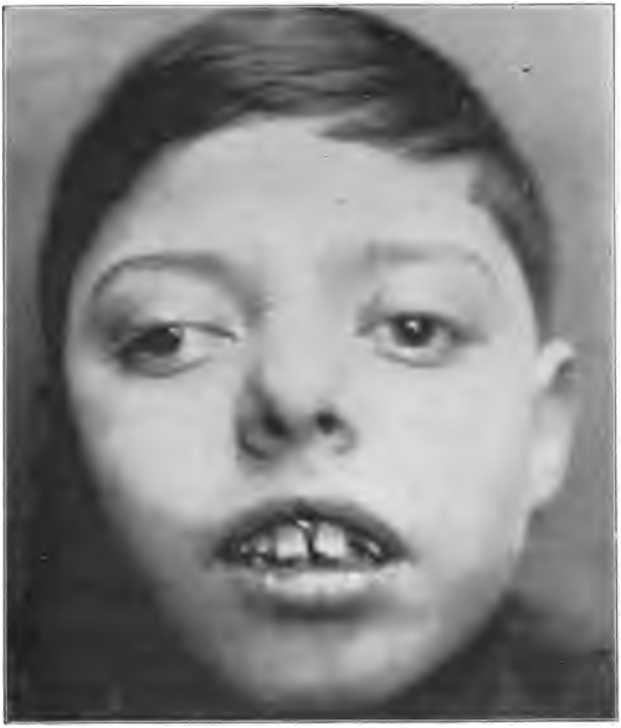

Fig. 27.—(Case 63.) Palsy of both internal recti muscles and of the right superior rectus muscle. "Frog face." O. S. fixing; O. D. deviating outward and slightly downward.

O.D. V. = 5/4 ; H. = 1 D.
O.S. V. = 2/60 ; H. = 1 D.

O.S., divergent 45 degrees; patient's face turned to the right, limitation in inward motion in O.S.; no secondary deviation in O.D.

CASE 65.—Female, aged 8.

O.D. V. = 5/5.
O.S. V. = 4/45.

O.S., divergent 50 degrees, and marked limitation of inward motion; object carried up, O.S. goes up and out; spasm of left rectus superior.

CASE 66.—Male, aged 13.

O.D. V. = 5/10 ; + 2 D.
O.S. V. = 4/50 ; + 0.50 D.

Holds head in oblique position to the left. O.S., divergent 20 degrees; fixing with O.S., O.D. deviates markedly under screen (overaction of right externus); marked limitation of inward motion in O.S., both above and below as well as in horizontal plane; O.D., ocular movements good.

CASE 67.—Female, aged 43.

O.D. V. = 5/10 ; H. + A.H. = 1 D.
O.S. V. = 5/ 7½ ; H. + A.H. = 1 D.

O.S., divergent 30 degrees; inability to rotate O.S. inward, eye being carried slightly up in vertical meridian; no secondary deviation in O.D.

CASE 68.—Female, aged 43.

O.D. V. = 5/4 ; H. = 5 D.
O.S. V. = 5/30 ; H. = 2 D.

O.S., convergent 30 degrees; inability to rotate O.S. internally; no secondary deviation in O.D.

PALSY OF INTERNAL RECTUS WITH PTOSIS O. D.

CASE 69.—Male, aged 16.

O.D. V. = 2/60 ; O.D. H. + A.H. = 1.5 D.
O.S. V. = 5/5 ; O.S. H. + A.H. = 1 D.

O.D., divergent 30 degrees; secondary deviation of O.S. to the left.

A type which is by no means uncommon is that in which there is a divergence of the visual axes. This may vary in degree from a moderate exophoria to an alternating divergent strabismus of high degree. In some of these cases, even though the degree of the divergence is great, the power of adduction is so strong that when the will is directed to the effort, the eyes may be made parallel. There is frequently an anatomic basis to be found in this type, either in the form of diverging orbits with a broad base line, or some abnormality in the insertion of the muscles into the globe. A skiagram (Fig. 29) made for me by Dr. C. L. Leonard of a recent case of this nature showed abnormally large ethmoidal cells and a slight spur-like projection of the internal wall of the orbit into the orbit. The spur is seen in its perpendicular section. Although the projection caused by the spur is slight, when taken in connection with the enlarged ethmoid cells, it would produce a definite change in the angle between the internal walls of the orbit.

Case 70.—Female, aged 28 (Figures 29 and 30).

O.D. V. + S. 1 D. ⊂ + C. 0.25 D. ax. 90° = 5/5.
O.S. V. + S. 0.75 D. ⊂ + C. 0.50 D. ax. 180° = 5/5.

The left was the preferred fixing eye, the right deviating 30 degrees (Fig. 30). There was no diplopia, the subject being able to suppress the image of either eye at will; the right rectus internus was advanced and a guarded tenotomy performed on the right externus with resultant parallelism of visual axes.

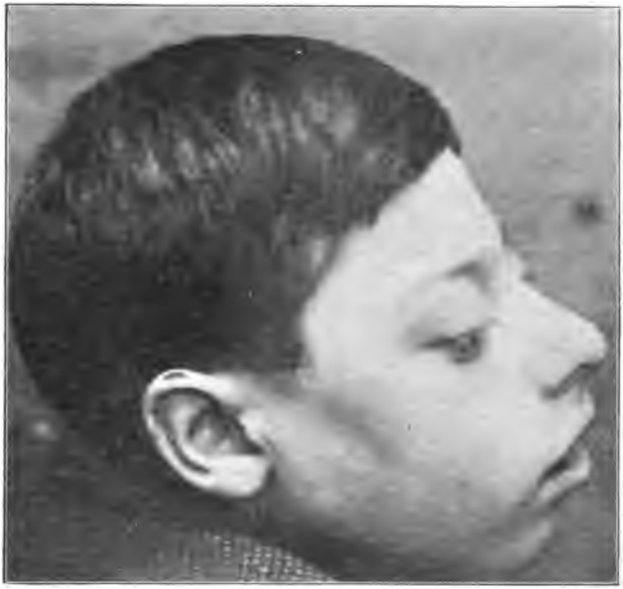

Fig. 28.—(Case 63.) Profile showing misshapen skull and shallow orbit.

To complete the list of types which may be assumed by cases of congenital palsy, there should be included that of paralysis of the externus with paresis of the internus and retraction movements, of which some 55 have been described by Duane. According to this author, the underlying cause of this condition is a congenital anomaly of the external rectus or its transformation into a connective tissue cord.

SUMMARY.

Of the 70 cases which have been recorded, anotropia occurred in 1 case; paralysis of both superior recti with paralysis of rectus externus in 1; paralysis of both superior recti in 3; paralysis of the right superior rectus in 7; paralysis of the left superior rectus in 9; paralysis of the left superior rectus and external rectus in 1; paralysis of the right superior rectus and levator in 1; paralysis of the right superior rectus and internal rectus in 1; paralysis of both superior oblique in 1; paralysis of right superior oblique in 1; paralysis of left superior oblique in 2; paralysis of right superior oblique and left inferior rectus in 1; paralysis of both inferior oblique in 1; paralysis of both inferior recti in 1; paralysis of left inferior rectus in 2; paralysis of right inferior rectus in 2; paralysis of both external recti in 4; paralysis of right external rectus in 9; paralysis of left external rectus in 9; paralysis of both external rectus and right superior and inferior rectus muscles in 1; paralysis of left external rectus with ptosis in 1; paralysis of left external rectus and right superior rectus in 1: paralysis of both internal recti in 5; paralysis of left internal rectus in 5; paralysis of left internal rectus with ptosis in 1.

Cases Nos. 7 and 8 and 36 and 37, with Case 1, illustrate the character of the deviation observed in three sets of twins.

Cases 2, 3 and 12 show the occurrence of the squint in both brother and sister.

In Case 14 the father was cross-eyed, and in 56 the father had an analogous palsy.

Operation was performed on Cases 6, 9, 10, 13, 15, 17, 28, 33 and 55.

While congenital squint is comparatively uncommon, its early recognition is of the greatest importance, not only on account of the treatment of the ocular condition itself, but also, if the squint be of central origin, by reason of the aid which the detection of the palsy in the eye muscles may give in the recognition of some obscure lesion in the nervous system.

From the standpoint of treatment, the necessity for the early differential diagnosis between congenital and concomitant squint can not be insisted on too strongly, for each manifestly demand different methods for their correction. In congenital squint no form of orthoptic exercise is of service, operative measures alone sufficing to straighten the visual axes, while in concomitant squint orthoptic measures if inaugurated early will often, in conjunction with proper lenses, accomplish all that is requisite.

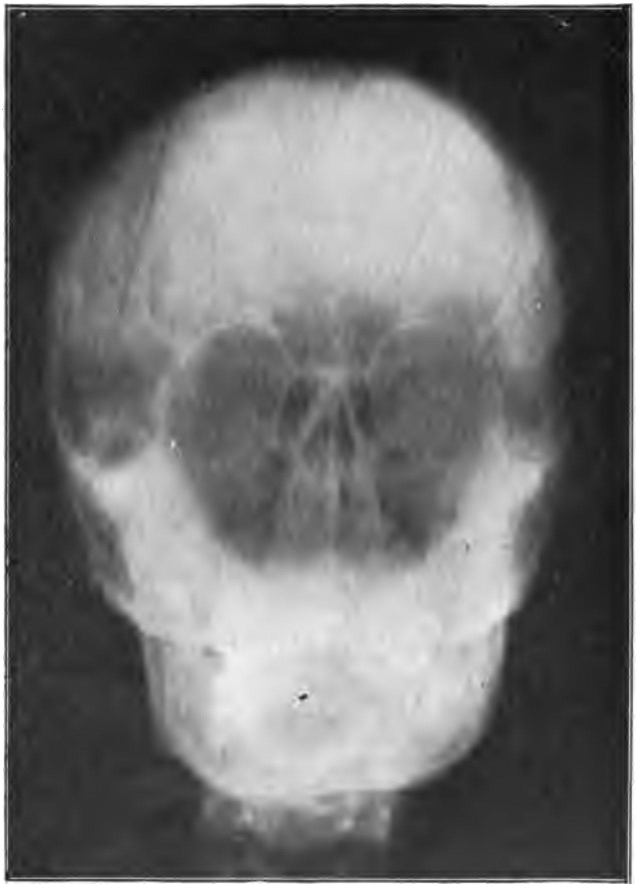

Fig. 29.—(Case 70.) Skiagram of skull showing enlargement of ethmoid cells with projection of bony spur into right orbit from internal wall.

The folly of subjecting paralytic cases to the strain and annoyance of amblyopic exercises is apparent, and this method, which is so potent in the cure of concomitant cases should not, therefore, be essayed. Refraction errors should be corrected, with a view to improving the vision in both eyes, though as both organs are employed in fixation amblyopia exanopsia does not develop in these cases.

The operative treatment of congenital squint obviously presents very great difficulties, but, as the deformity is often very marked, its relief should always be attempted. Before proceeding to operation, however, it goes without saying that the ophthalmologist should first study the case in all its details, with a view to discovering, as far as is possible, the muscles at fault and the direction in which the movements of the eye need supplementing or curtailing. At times exploratory incisions over the normal insertions of the muscles are of advantage before the actual muscle which is to be operated on is selected. In many of these cases the absence or underdevelopment of a muscle or the presence of fibrous bands will so modify the rotation of the eyes that all rules which govern the operator in the performance of operation in ordinary cases of squint must be abandoned, and he will be compellled to proceed on entirely new lines. Tenotomy of one or more muscles with advancements of associates will usually have to be performed, for a single operation rarely suffices to materially improve the condition.

Operative procedure in this class of cases should be performed in the neighborhood of 10 years of age; the permanent character of the deviation is rarely fully established until that age, and in the event that advancement is demanded younger subjects are usually too restless to permit of the immobility of the eyes which is so desirable after advancement, and the tissues of the eyes too delicate to enable the stitches to be properly embedded.

To overcome the overaction of the inferior oblique muscle, tenotomy was performed on this muscle in five of the recorded cases, the tendon being divided near its point of origin at the lower inner margin of the orbit, through a skin incision which followed the rim of the orbit. Contrary to the experience of **Duane**,[12] **I have** obtained but a limited effect from this procedure, for, although the tilting of the eye upward and inward was lessened in all instances by it, this deformity was never wholly removed. The photographs (Figs. 5 and 6) illustrating Case 9 demonstrate the overaction of the muscle as a consequence of palsy of the right superior rectus, and show the effect of tenotomy in relieving the deviation. The procedure is an extremely simple one; the scar of incision soon disappears, and I acknowledge my indebtedness to Duane in bringing the operation into prominence and for the indications which he has given for its employment.

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[12] British Med. Assn., Toronto, August, 1906.

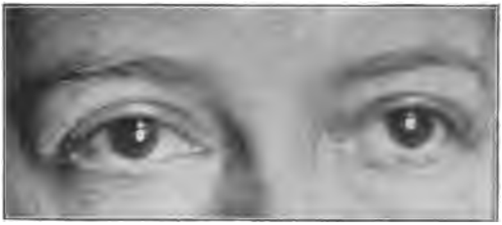

Fig. 30.—(Case 70.) Divergence of visual axes. Paretic action of both internal recti muscles; most pronounced in the right eye. Slight overaction of right superior rectus muscle.

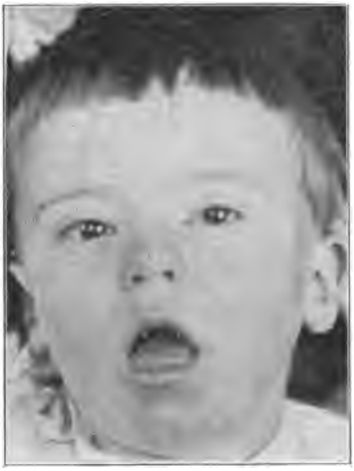

Fig. 31.—Case of Mongolian idiocy, showing convergent strabismus in right eye. Paresis of both external and superior recti muscles.

In closing, I desire to express my thanks to Drs. Walton C. Swindells, Frank C. Parker and Jay C.

Knipe, chief assistants in my various clinical services, for aid in observation of the cases and in preparation of the notes, and to Drs. Swindells and Parker in particular for their kindness and skill in photographing many of the cases, some of the most interesting of the reproductions being incorporated in this paper.

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